Gas Journal

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Editorial Notes

Dealer Co-operation

INTEREST in the question of dealer co-operation, the extensive practice of which in the United States created such an impression on the delegates of the Institution of Gas Engineers during their visit to Canada and the States last year, is intensified by a co-operative scheme recently launched by the Gas Light and Coke Company and so far advanced that more than 150 authorized dealers have already been enlisted. It seems to us that the matter is of such importance that recommendations should be made to the Industry in general, instead of allowing it to develop spasmodically by isolated undertakings. Here is a line of policy for the Joint Co-Ordinating Committee to consider.

It is, of course, an extremely difficult problem owing to the diversity of the sales methods adopted by different undertakings—a diversity which many another industry would consider verges on the chaotic. The prices at which appliances are retailed vary widely from area to area and even in adjacent districts. Some concerns install appliances, fixing them "free," at a cost which allows an extremely small margin above the original wholesale price to the undertaking. Others have a much wider margin to cover fixing costs and service charges. Obviously then, if dealer co-operation is to be pursued effectively throughout Great Britain some agreement will have to be arrived at as to the margin of profit on the sale or hire-purchase of apparatus, and, of course, in no circumstances can any such scheme achieve success unless the dealer is able to fix his prices in accord with those offered by the gas undertaking, and at the same time be assured of a monetary gain which will provide him with ample incentive to push the sales of gas appliances.

Changed Conditions

CO-OPERATIVE trading, we suggest, offers so many possibilities that the active attention of the Industry should be brought to bear upon it, and in this connection one cannot with any measure of justification put forward the arguments of twenty or more years ago as applicable to conditions which have completely changed. Prior to, and after, the War it was imperative that the Industry should take into its own hands the installation of gas appliances. For the most part installation work was undertaken by plumbers and builders who, in spite of the signs on their doors and windows, knew next to nothing about gas fitting in relation to gas service. Premises by the thousand were carcassed with pipes totally inadequate to cope with the demands of the consumers. Fires and water heaters were connected up in a most indecent way, the result being an ugly failure. Complaints of "bad gas" were the order of the day. So the Industry did the only possible thing in their campaign to educate the public as to what gas service really means. Showrooms were erected appropriate to the business in hand, and individual undertakings saw to it that the fitting work and servicing in general was up to specification.

The outcome of this work needs no recounting here. The standard set up and maintained by the Gas Industry is indeed the envy of our competitors. Whatever is done now and in the future in regard to dealer co-operation must never result in the lowering of this standard. Nor can dealer co-operation ever be a substitute for the erection and adequate staffing of showrooms by gas undertakings themselves. It has been proved all along the line that showrooms are essential to gas progress and definitely a paying proposition in the widest sense of the term. On the other hand, there can be no question but that this very necessary move to modernize gas service and to enable all and sundry to enjoy it to the full antagonized the small dealer. This was inevitable, and, of course, he became biased in favour of coal, oil, and electricity—even to the exclusion of gas. Where dealers continued to show gas appliances, in ninety-nine cases out of a hundred the appliances shown were a discredit to our Industry.

An Opportune Moment

THE time has come, however, we think, to consider seriously a general move to enlist the support of the dealer—and in "dealer" we include plumbers, builders, decorators, ironmongers, general stores, and furnishing houses. To-day, if one walks down any busy shopping thoroughfare in practically any town, one comes across dealers who might well display and take an active interest in the sale of high-class gas appliances approved by the undertaking in whose area they carry on business. We do not for a moment suggest reversion to the conditions of twenty years ago. We maintain that any dealer co-operative plan should have as a *sine qua non* strict supervision of installation work by the gas undertaking, but we think there is much in favour of *approved* dealers indicating by both their attitude and

their willingness to display up-to-date apparatus a belief in modern gas service.

We have said that showrooms are essential. The fact, however, that their work requires supplementing has been shown very clearly by those who, in addition to having both central and district showrooms, have realized the need for mobile showrooms as well. We well remember the account which Mr. Bloor, of York, gave as long ago as 1928 of the value of his travelling showroom not only in the outlying villages of the Company's area of supply, but also in the City of York itself. The results obtained only a mile distant from the central showrooms caused general surprise and showed how necessary it is for Mahomed—meaning the Gas Industry—to go to the mountain of consumers. Mr. Bloor demonstrated that an enormous amount of possible business was not being touched by the central showrooms even at a distance of one mile. But—and here is an important point—appreciable business was done at the central showrooms following upon the visit of the travelling showroom. These proved practical results suggest the desirability of co-operative trading. They show that business can be led from the dealers' shops to the gas undertaking showrooms, while at the same time the appliances displayed by the dealers serve to counteract a great deal of coal, oil, and electricity propaganda and direct business. We can well imagine that in certain areas some dealers will not be easy to approach by the gas undertakings. They will say, in fact, you " gave us the bird " when you thought it paid you, and now you come to us for support when you are in difficulties. As we have indicated, however, this view is untenable, because, unless the Industry had taken the steps it took, the consumer would have been the sufferer, and also the dealer. Moreover, the progressive dealer of to-day must see that customer satisfaction is in his own interest. What we have to do is to create in the dealer a live interest in the gas business, and pay him for the work he does.

The Gas Light Plan

We may set out here some of the main points about the Gas Light and Coke Company's new plan. The dealer is asked to provide space for display and to take a keen interest in the work. He is asked for no capital, for the stock is supplied by the Company, who also loan the necessary material for displays and demonstrations. The idea is that authorized shops shall in part be gas showrooms. No restriction is made as to the type of appliance sold except that it must be approved by the Company. The trader receives a commission on sales and on any business he may introduce, and if he prefers he can take his customers to the nearest showrooms of the Company. All the necessary contract forms for hire and hire-purchase business are supplied, and on these terms the customer pays direct to the Company, so that the dealer is spared the duty of collecting money. The scheme is in its infancy, but it has already resulted in a large increase in direct contacts with the ordinary householder and the property owner, which are so important for increasing the sales of gas equipment.

The Gas Light and Coke Company is not, of course, the only undertaking, and it is by no means the first, to adopt some form of co-operative trading. The fact, however, that it has in its extensive area put such a scheme into operation constitutes a very important lead to the Gas Industry. The Croydon Gas Company has for some time demonstrated the value of co-operation with local traders, and in their case the sales agents' agreement is extended to contractors employed in carrying out the district fitting work augmented by the Company's own fitting staff. The outside contractors become " gas minded " and recommend gas appliances when otherwise they would have no interest. It is to be particularly noted that supervision is given by the Company to ensure the correct method of work, and, highly important, the way to conduct this work on consumers' premises. Other examples of co-operative trading of one kind or another are provided by Newcastle, Birmingham, Bristol, and Nottingham. Still another example is the Tottenham Company, who, by the employment of approved outside contracting firms, are able to establish a permanent staff of skilled fitters and retain this staff irrespective of the amount of work the department is called upon to perform.

The business of the Gas Industry is to sell gas, and provided there is adequate safeguard in planning co-operative trading, the scheme, as we see it, has a great deal to be said for it; but if it is to be fully effective it demands a national effort rather than one or two local schemes, however enthusiastically these are carried out, and with whatever success. And we wonder to what extent some national certificate of approval for the appliances sold by the dealers would be beneficial. This reopens a question regarding which we are well aware there are two opposing camps, and we do not intend to enlarge upon it for the moment; but discussion of co-operative trading leads one naturally to the problem of the certification of gas appliances on a national basis.

"To See Ourselves . . ."

We publish on later pages what is definitely a " racy " article—vigorous and homely. It is from the pen of Mr. Stanley Jenks, Sales Manager of a number of Public Utility Companies in the United States of America, and whose articles on " Gas Appliance Merchandizing in the United States " are proving such a welcome and popular feature of the " Gas Salesman." Mr. Jenks, who has spent the best years of his life in the " sales end " of the gas business, has just concluded a visit to Great Britain, and he gives in to-day's " Journal " his impressions, as an American gas man, of an extensive trip through England and Scotland visiting many gas undertakings, large, small, and medium, municipally and privately owned. His views, however unpalatable some may find them, are of added interest in that they follow on so closely the impressions made by the American Gas Industry on three delegates of the Institution to Canada and America last Autumn, expressed by Colonel Carr, Mr. Masterman, and Mr. Carmichael at the Institution meeting last June.

In addition to visiting gas undertakings, Mr. Jenks " sized-up " the position of the dealer in regard to the sales of gas equipment. It is obvious from his article that he called upon dealers who had not been approached by gas undertakings in any co-operative spirit, for he discovered no single instance of any friendly feeling of the dealer towards the Gas Industry. Some dealers, he says, were simply apathetic; the others were " bitterly hostile," and some took a " venomous delight " in selling oil cookers and other competitive appliances. Though we think he " struck a bad patch," we feel that in general this impression must hold good, though the attitude of ironmongers and hardware merchants to the Gas Industry in this country must appear doubly strange in the spot-light of one who has had such a different experience of co-operative trading in the States. We think it very likely that when Mr. Jenks renews his acquaintance with the Old Country he will sense a friendlier feeling.

The foregoing is one of many strong impressions gained

by Mr. Jenks and equally strongly expressed in his typically American " go-getter " article. What strikes him more forcibly than anything else is that sales of gas in Great Britain are " suffering from engineering domination "—that in so many cases those responsible for the management of gas undertakings spend 90% of their time in keeping up the holder, and very little of the remainder in developing further markets for the use of gas. We believe that Mr. Jenks, even if wrong in his arithmetic, is in essence right, and that where this " engineering domination " exists it inevitably results in apathy in the showroom and on the district. How can salesmen be expected to put forward their best efforts when they themselves are put in the background of the general scheme of things? However, growing competition must alter this, and we would suggest once again that when Mr. Jenks re-visits Great Britain he will see a change more in keeping with his notions of gas progress. All the while, we must call attention to Mr. Jenks's view that in the art of production, distribution, and application, we are " miles ahead " of our American colleagues. Thank you, Mr. Jenks.

Why Such Sacrifice?

We gather from Mr. Jenks that we are very lop-sided—that we sacrifice on the altar of Thermal Efficiency the Goddess of Sales Beauty. Our cookers, for example, have no " sex-appeal." The housewife, he maintains, is not so vitally concerned with another useful B.Th.U. in the oven, but she can be " sold " on the appearance of a cooker. This, we suppose, is largely true, but we are not at all sure that we are not on the right lines in enthusiastically carrying out research to improve appliance performance. Mr. Jenks must not base the opinion of the Gas Industry on a conversation with a specialist technical research worker. We are not unaware of the volume of experiment undertaken by the American Gas Association into precisely similar questions; and we cannot support the view that the " British gas salesman is succeeding *despite* the efficiency fanatics who are shackling his efforts." These efficiency fanatics are the most important factor in the ultimate production of new and better appliances both for the home and for industry; and we for our part are not nearly so despondent as Mr. Jenks about the " sex-appeal " of the modern British gas cooker.

What we obviously do need, however—and here we are in hearty agreement with Mr. Jenks—is better sales planning. In far too many instances, as he remarks, there are no plans at all, and in far too many instances, where there are plans they are organized all too casually.

Too Many Platforms?

We are not infrequently taken to task by our friends for providing them with what they describe as a surfeit of reading matter. It is issues such as this week's which call forth comments of this kind, and our inevitable answer is that everything interests *somebody*, and that no one need read that which does not interest him. If anything that has happened in one week is crowded out by sheer weight to the next, we can be quite certain that somebody will ask why. And indeed we would not have it otherwise, recognizing the need, with which we know there is general agreement, that a great technical industry like ours must have a technical paper, as distinct from a trade paper, to supply promptly, fully, and accurately the record of current thought and achievement. We take it as no part of our function to decide what shall be read by whom, and, as we have already remarked, everything appeals to somebody. Moreover, we know only too well by experience that what was said yesterday will be referred to again a year hence, two years, or even ten years hence. And the Gas Industry always knows that it can find it in the " Journal."

Now surely, if there *is* overweight of material to be digested by the super-conscientious reader, the fault lies not with ourselves, but with those who provide the enormous quantity of papers and discussions in these days. Then, again, if blame there should be, it cannot be assigned to the individuals who produce papers so much as to the organization of the Industry which provides such a multiplicity of platforms. This is a large question, and part perhaps of an even larger one which we do not propose to discuss at the moment. But it is becoming more and more a question as to whether issues are not being confused by the method of their presentation, and a question to which the serious student of gas affairs must give thought.

In the meantime, we can commend to our readers much admirable material in this issue. In addition to a summary of the Institution Autumn Research Communications (supplementing those which we have previously given in the " Journal "), there is excellent fare from the Eastern Counties and the Manchester Associations. By a first-class paper at the former from Mr. F. B. Richards, and a friendly controversy between two distinct schools of thought, the interest in Mr. Brockway's year of office as President was sustained at the high level at which it was begun. On this meeting we comment later.

The Manchester meeting drew a large gathering of members to discuss industrial gas, and the paper presented was a description of certain processes which were later inspected actually doing their several jobs of work. A few weeks ago we were able to record how Stretford has more than recovered the industrial load which it lost when Ford's works packed up and migrated southwards three years ago—a little loss of 114 million cubic feet annually which might well have daunted one with less faith and less foresight than Colonel Carr. His faith and his foresight were both evident at the meeting, and subsequently the members were delighted with the way in which they saw him making the best of both worlds by supplying large quantities of gas to a firm turning out many miles of electric cable in a year.

It must not be imagined that such loads as the Stretford Undertaking has achieved are theirs for the asking, and the interesting discussion which took place at the meeting revealed some of the methods by which they are won. Experiment, investigation, rate structure, constant touch with prospective consumers, these are a few of the important points. And, having once put forward a proposition, Colonel Carr is always prepared, within reason, to put in the plant at his own risk, on the principle of no payment unless the customers get results. We believe they always do.

Gas Making Costs

In his paper Mr. Richards took members of the Eastern Counties Gas Managers' Association in his autogyro, to enable them to enjoy a bird's-eye view of their works in relation to ultimate economy. Messrs. Humphreys & Glasgow have their own machine, and after the foregoing flight the members were invited to a trip on the H. & G. plane. The result was a general realization that no two birds see alike.

The reason for these flights—we will not say into the clouds—was the publication in the " Journal " for

Aug. 23 and 30 last year of a treatise by H. & G. on carburetted water gas as a coal gas auxiliary, and we were quite right in suggesting at the time that the treatise would cause more than a flutter in gas engineering circles. Mr. Richards disagrees with the premises on which Messrs. Humphreys & Glasgow based their arguments, and he approaches the problem as one associated with coal carbonization. In between the two differing viewpoints, he maintains, the gas engineer will determine the *via media*. With which line of thought Messrs. Humphreys & Glasgow disagree, because they contend that their treatise from the outset travelled along the middle path. "I'll take the high road and you'll take the low road. . . ." We offer no opinion as to who will reach the destination first, but we do say that the methods of approach of two of the Industry's most respected firms, whose brilliant researches have so greatly benefited the progress of gas, are full of interest. They provided splendid technical fare at the meeting of the Eastern Counties' Association, and they will, through our columns, excite widespread comment. And we are glad of the axiom that coal carbonization and water gas manufacture go hand in hand.

Assessing the Variables

We may here give emphasis to one or two of Mr. Richards' important conclusions. On the basis set out in his paper he shows that the cheapest gas is made when retorts are worked at their maximum thermal output per retort per day. The leading influence on cost of manufacture is the price relationship between coal cost and returns for coke and tar. For a coal which is amenable to steaming there is little difference in the retort house cost of gas production over the range 500 B.Th.U. to 450 B.Th.U., but the lower the value for coke, the more the attraction to make low calorific value gas. Against the retort house saving with low calorific value gas must be offset the increased works cost. Breeze burning by reducing the fuel cost is a paying proposition. And, finally, labour cost represents less than 8% of the final cost of gas *ex* retort house. It is easy by excessive cutting in labour schedules and consequent reduction in general plant efficiency to increase cost of production. The foregoing points show how necessary it is to maintain a sense of proportion, a right perspective, in assessing the variables which influence the final result—the cost per therm.

We also emphasize the following remarks of Mr. Richards: "To maintain a true perspective of the comparative costs of gas production in continuous vertical retorts and intermittent vertical chambers, it is necessary to observe that the retort house cost of gas production does not account for more than 25% to 33% of the selling price of gas. Further it has been shown that there is relatively little difference in the cost of gas production from these two types of plant under similar conditions. Therefore other factors, such as nature of coal available, type of coke required, calorific value of gas required, size of installation, and local amenities, usually play a predominant part in the selection of new plant."

The Therm at the Burner

We would go a step further in this attempt to arrive at a true perspective, and, reverting to the coal gas *versus* water gas controversy, suggest that the "type of therm" as distinct from the cost of the therm is of the utmost importance. An unsuitable therm, for example, for meeting peak loads may be cheaper than a suitable therm, but it does not necessarily follow that the saving in cost of therm into holder is justified. Only last week we commented on this matter in connection with Mr. F. C. Smith's Presidential Address to the London and Southern District Junior Gas Association. We queried whether we should not insist on a limited range of variation in the specific gravity of the gas supplied to that very humble servant, the salesman. We said: "It needed an Act of Parliament, fourteen years ago, to enable the salesman to deal with heat instead of cubic feet. . . . The designer of a gas burner knows that his nice calculations may in practice prove meaningless. We ought to work to an agreed composition code, with adequate specific gravity clauses." In no circumstances should the gas engineer permit variations in composition and specific gravity outside the limits imposed by the most sensitive apparatus on the district.

In view of this we are glad that during the discussion on Mr. Richards' paper Mr. Townsend, of Colchester, emphasized that the question of the price of the therm must be considered jointly with the quality of the therm. "It is high time," he said, "that we had a specification for gas. . . ." Mr. Townsend shares our view that a true perspective of gas-making costs must include the performance of gas on the consumers' premises.

Smokeless Domestic Fuel

We have received a blue book—this one a Cambridge blue—from the South Metropolitan Gas Company embodying within its covers the findings of team-work research on the production of suitable smokeless domestic fuel for closed stoves and for the open firegrate. It is a most unusual and most valuable contribution to our knowledge of the subject, and should appeal vitally not only to the Gas Industry, but also to the carbonizing industries in general. We hope that it may prove the forerunner of publications on similar lines, not necessarily on the same problem.

The South Metropolitan Gas Company was early in the field in its investigations to produce by carbonization a smokeless fuel acceptable from all points of view to the domestic consumer. The researches have been directed not only to high-temperature carbonization, but to low-temperature carbonization—or, perhaps, it would be better to say modified low-temperature carbonization. The Company has had considerable experience of several types of low-temperature plant, and for some time now has been operating under licence the "Coalite" process and marketing the solid product as "Metro-Coalite." This smokeless fuel has met with ready acceptance, and it is of particular interest that the demand has been very largely from the less well-to-do section of the Company's consumers.

It would appear that the Company has been attacking the whole problem from two distinct angles. First, the marketing of a smokeless fuel suitable for use in any form of grate. Secondly, the design and production of special grates capable of burning "ordinary" high-temperature coke. The pioneer "Metro" grate, most ingenious in design, has led to the manufacture of other models which have enormously extended the sale of high-temperature coke for room heating. And, from our reading of the new blue book, the Company's researches into low-temperature carbonization have opened up great possibilities for the Gas Industry.

A Team-Work Publication

It is with these methods of attacking the coke market in mind that we call attention to a significant sentence in the preface of the publication. "E.V.E." states: "It is considered that as the general trend of evidence of the work about to be described points so conclusively in one direction, in that direction the truth may seem to lie." Those interested will grasp the sign on the post.

We have used the expression "team-work" in connection with this publication, which is entitled "The Solid Products of Carbonization," to indicate the underlying principle of the Chemical Department of the Company in giving expression to co-ordinated research. "It is essential," states "E.V.E.," "for the success of a chemist's work that from time to time he should discuss with his colleagues his experimental findings as well as his ideas. This discussion tends to promote healthy criticism, the destruction of unsound conclusions, and the development of nebulous ideas into useful working hypotheses. Collaboration of this nature proceeds daily in an industrial laboratory, and in the laboratories of this Company it is specially encouraged with the object of attacking problems by a team of workers. The various members of the laboratory staff, by training and experience, become adept in different specialist branches of their science, yielding, for example, the physical chemist, the organic chemist, and the chemist with a flair for work on the technical scale. Experience has shown that a problem is solved more quickly and more satisfactorily by the combined efforts of several individuals each having a different outlook than by the sole endeavours of any one of them. Such a system offers many advantages during the progress of the work, but when it is desired to publish the results, certain difficulties arise. During a prolonged investigation ideas are contributed from many members of the laboratory staff, and although the general progress of the work may be directed by one or two individuals, it is not equitable that the privilege of publication should be enjoyed by these individuals alone. Moreover, if private publication by individuals be encouraged there is a tendency for the general nature of the laboratory work to undergo a change, for much of the investigatory work in an industrial laboratory is non-spectacular and only a few investigations are of such a nature that, in themselves, they are suitable for presentation as scientific papers. The opportunity for private publication leads to a desire to undertake those neater and more spectacular pieces of work and a tendency to neglect investigations having less publicity value."

The thanks of the Gas Industry are due to the South Metropolitan Gas Company for publishing this work on a phase of the Industry's activities which daily assumes added importance. The book is reviewed on a later page of the "Journal" to-day.

The Stamping of Gas Meters

A case of considerable interest was heard at the Ashton-under-Lyne Police Court on Oct. 22. The case arose out of the prosecution by the Board of Trade of the Ashton Gas Company, which was alleged to have given a supply of gas by means of a meter which was not stamped in accordance with the Gas Meter Regulations, 1920. The Justices dismissed the case against the Gas Company, and awarded them 5 guineas costs.

The facts of the case make interesting reading. It was admitted that the meter had been properly stamped when purchased by the Gas Company in 1906, in accordance with the Sale of Gas Act, 1859. In the course of use, however, the stamp upon the meter had become illegible, although there was no suggestion that the meter had been tampered with, or was inaccurate, or that the consumer had been improperly charged. The Gas Company, therefore, relied upon section 10 of the Sale of Gas Act, 1859, which provides that no meter duly stamped shall be liable to be re-stamped unless found to be inaccurate.

The Board of Trade, however, contended that this section of the Act cited had been impliedly repealed by section 13 of the Gas Regulation Act, 1920, which provides that all meters by means of which gas is supplied by any undertakers shall be stamped in accordance with regulations made by the Board of Trade. Under this section the Board of Trade have made the Gas Meter Regulations, 1920, which provide that "every meter shall be stamped in such manner as in the opinion of the Board of Trade will best prevent any tampering with or alteration of the mechanism of the meter; and that in general a meter shall be stamped in the following manner—

(1) On the exterior of the index box or cover of wet meters in such a position that the box cannot be opened without the seal being broken.

(2) On such conspicuous place or places on the body of the meter as may appear to be necessary to prevent the opening of the meter for adjustment without the breaking of the seal."

The question of importance was whether the meter, having been stamped in accordance with the Sale of Gas Act, 1859, was a legal meter, notwithstanding the fact that the stamping did not comply with the Gas Meter Regulations, 1920. The Bench held that section 10 of the Sale of Gas Act, 1859, had not been repealed by the Gas Regulation Act, 1920, and, therefore, provided it was not inaccurate, there was no obligation to have a meter, originally stamped before 1920, re-stamped in accordance with the Gas Meter Regulations, 1920.

This decision is of obvious importance. The suggestion that gas undertakers should be obliged to re-stamp all meters stamped before 1920 is one which is utterly impracticable. The fact that 7,000 meters of the Ashton Company alone were affected is an indication of the immensity of the obligation which would be imposed on the Gas Industry throughout the country. The decision of the Ashton-under-Lyne Justices to the contrary is, therefore, one that commends itself both from the point of view of law and of common sense.

The British Gas Federation.

Inaugural Dinner.

At the time of going to Press, we are gratified to learn from the Secretary of the Dinner Committee that acceptances, including those of Members and Official Guests, have passed the 600 mark.

Official Guests include Members of H.M. Government and of both Houses of Parliament, Government and Local Government Officials, Presidents of Kindred Associations, Scientists, Industrialists, Editors, and others prominent in public and business life.

The Speakers will be Lord Macmillan (President, The British Gas Federation), the Marquess of Londonderry (Secretary of State for Air), Dr. E. Leslie Burgin (Parliamentary Secretary, Board of Trade), and Sir David Milne-Watson.

The Band of H.M. Scots Guards will play.

Personal

MR. HAROLD COPP.

A Presentation by the British Gas Light Directors.

Mr. Harold Copp was entertained at dinner at the Royal Station Hotel, Hull, on Oct. 26, by the Directors of the British Gas Light Company.

The Chairman, Mr. HENRY WOODALL, J.P., presided. In proposing the toast of "Our Guest" he said: "There must be a note of sadness about this meeting, but it is a note which does not predominate. We are met to say goodbye to an old friend and associate of many years' standing. Our friend Mr. Harold Copp has spent all his life, not now a very short one, in the Gas Industry, and his record is one of which he has every reason to be proud. He did good work before he joined our Company. He has been with us for twenty years and eventually became our Chief Engineer. Mr. Copp was elected in 1930 to the highest position a Gas Engineer can occupy—namely, that of President of the Institution of Gas Engineers, and during his year of office he presided at the first International Gas Conference held in London in 1931. On all occasions he carried out his numerous duties with dignity and credit.

"Mr. Copp's life is one that he can look back upon with great satisfaction. He adopted gas engineering as his profession, and, starting as a junior engineer, became the head. We and he are very proud of our Hull Works; they are a model of what a gas-works should be, thoroughly efficient and beautifully kept. Mr. Copp might well say—'Si monumentum quaeris circumspice,' which may be translated, 'If you question my merit, behold my work.'

"Our friend is wiser than many in retiring when he still has vigour and full power of enjoyment. We wish him and Mrs. Copp every happiness in the future.

"On behalf of the Directors of the Company I now ask Mr. Copp to accept a silver salver and tea service, and may it remind him and Mrs. Copp of a long and happy connection with the old British Gas Light Company."

Mr. HAROLD PALMER, Deputy-Chairman, having supported the Toast,

Mr. COPP, sincerely thanking the Chairman for his very kind remarks, said that he had received innumerable kindnesses at his hands since he had had the honour of serving the Company, and spoke of the gratitude he had always felt for his revered father, the late Sir Corbet Woodall, for the kindly advice and guidance he had received from him in his younger days.

He felt somewhat overwhelmed by the surpassing kindness of the Directors in coming to Hull in order to do him honour that evening, and for the magnificent gift with which they presented him. It would be a lasting joy to himself and to Mrs. Copp, and they would both treasure the gift and value it as a token that he was retiring from the Company's service with the goodwill and good wishes of the Court of Directors.

Mr. Copp expressed his gratification that he was being succeeded by his old friend, Mr. C. Rhodes Armitage, who followed him at the Potteries, and sincerely wished him every success in his new sphere of work for the Company which he had been so proud to serve for the past 20 years. He also paid a tribute to the loyal co-operation of the officials and workmen at the Hull Station, and had no doubt that this would be extended to his successor, as it was essential to success.

The silver salver accompanying the tea service bears the following inscription:

> "Presented to Harold E. Copp, M.Inst.C.E., with the best wishes of the Directors of the British Gas Light Company upon his retirement after 20 years faithful service."—October, 1934.

The CHAIRMAN, in proposing the Toast of Mr. C. Rhodes Armitage, welcomed him on his appointment to the Hull Station. In replying Mr. Armitage thanked the Court of Directors for their continued confidence in him; also for the help which he had invariably received from the Chairman, and it was only the knowledge of the continuance of this help, together with the assurance he had received from the Chief Officials of their loyal support and help, that had decided him to accept the appointment.

In addition to the Court of Directors, there were present at the dinner, Mr. A. J. Mumford, Secretary; Mr. G. S. Hatton, Accountant; and the Chief Officials at the Hull Station.

Mr. Copp asks us to announce that his new address is:
Addison House,
Sutton-on-Hull, E. Yorks.

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Alderman WILL MELLAND, J.P., who has been Chairman of the National Smoke Abatement Society for ten years, has resigned that position, but will continue in the office of Hon. Treasurer. The new Chairman is Mr. CHARLES GANDY, barrister-at-law, who has served on the Executive Committee and has taken a keen interest in the work of the Society.

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It is announced that Mr. FRANCIS CECIL ST. ALBYN has joined the Board of the South-Western Gas Corporation.

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After six months' furlough in this country, Mr. S. BARKER JOHNSON, Manager of the Colombo Gas and Water Company, Ltd., sailed for Colombo last Saturday.

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At the annual meeting of Eyemouth Gas Company held on Friday, Bailie R. PHILIP was appointed Chairman of the Company in succession to the late Mr. W. Flett.

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The Cambridge University and Town Gas Light Company have appointed Mr. E. HARDIKER, F.C.S., M.Inst.Gas E., as Engineer and Manager in succession to the late Mr. J. W. Auchterlonie. Mr. Hardiker comes from Smethwick, where he has been Engineer and Manager of the Gas Department since 1922.

Obituary

From Lausanne comes the news of the death of M. FRANCIS GILLIARD, who was Chief Engineer of the Gas Undertaking in that town from 1918 to 1933.

* * *

The death took place last week at her residence, "Tirionfa," Holyhead, of Mrs. IFAN JONES, wife of Mr. A. Ifan Jones, J.P., M.Inst.Gas E. (Secretary and General Manager of the Holyhead and North Wales Gas and Water Corporation, Ltd.). Mrs. Ifan Jones was a very popular lady and was well-known throughout the district for her social and charitable work. She leaves two sons, Mr. O. R. Jones, who is Assistant General Manager to his father, and Mr. A. E. Jones, Secretary and General Manager of Fairfield Garages, Ltd.

Forthcoming Engagements

November

1.—MIDLAND ASSOCIATION.—Autumn General Meeting, Grand Hotel, Birmingham, 2.30 p.m. Paper by Dr. F. S. Sinnatt.

1.—MIDLAND JUNIOR ASSOCIATION.—Meeting in Birmingham. Paper by Mr. J. A. Johnston.

3.—WESTERN JUNIOR ASSOCIATION.—Meeting at Bristol. Paper by Mr. A. T. Gilbert.

6 and 7.—I.G.E.—Autumn Research Meeting.

8.—S.B.G.I.—Council Meeting, 11.15 a.m.

8.—S.B.G.I.—Autumn General Meeting, Hotel Metropole, 2.30 p.m.

12.—GAS COMPANIES' PROTECTION ASSOCIATION.—Annual General Meeting, Caxton Hall, Westminster, 2.30 p.m.

15.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m.

16.—SOUTHERN ASSOCIATION (WESTERN DISTRICT).—Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.

21.—B.C.G.A.—Manchester District Conference at Altrincham.

21.—B.C.G.A.—Meeting of Executive Committee, 28, Grosvenor Gardens, S.W. 1, 12 noon.

23.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting. Paper by Mr. T. G. Noble.

24.—N. OF E. AUXILIARY ASSOCIATION.—Half-Yearly Meeting at Newcastle. Paper by Mr. W. O. Kirkwood.

24.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION. Meeting at Swansea. Paper by Mr. Stewart John.

30.—SOUTHERN ASSOCIATION.—General Meeting, Hotel Metropole, London, 2.30 p.m.

Wandsworth and District Gas Company
1834-1934
A Fine Record of Public Service

The Thames, the Wandle, an easy and cheap transport of coal must have composed at least one trinity of ideas in the minds of those who, early in October, 1834, called a meeting of several inhabitants of Wandsworth and Putney for the purpose of considering the advisability of establishing a gas-works. A provisional Committee was appointed, and in little more than a fortnight it recommended to a special meeting that it was highly expedient that the parishes of Wandsworth and Putney should be lighted by gas. The Wandsworth and Putney Gas Light and Coke Company, Ltd., came into being, its capital being £5,000.

Water borne coal must be counted among the secrets of the Company's success through the one hundred years of its operations, for in the earliest days the coal was brought up to the works in small barges and was discharged by hand and run into the coal stores by means of hand barrows. If only the labourers of the time could see the modern method!

At the completion of the first twenty-five years of the Company's existence a steady 6% dividend was being paid to the shareholders; the price of gas had been reduced to 5s. per thousand; expansion had been steady, and an agreement had been approved to supply gas to the streets of Battersea.

In 1866 Mr. H. E. Jones joined the Company as Engineer and Manager. He became a very active figure and soon recommended the hiring of meters to consumers on a graduated basis according to the number of lights.

The Collier Fleet.

Coal requirements increased and the laborious transport by barges gave birth to the idea of colliers coming to the wharf at Wandsworth, but so many difficulties presented themselves that the project had to remain in abeyance for some years. There came a time, however, when it was revived and pursued with energy, and ultimately on a memorable day in 1906 the s.s. "Ratcliff" delivered direct a cargo of coal. Three years later the Company took the bold step of putting into commission a collier of their own to bring coals direct from Newcastle to Wandsworth. It was specially built for the Company and was appropriately named s.s. "Wandle." It was little thought at the time that this vessel was to become famous during the Great War, or that it would be the forerunner of a fleet that is the Company's proud possession to-day. It was ultimately lost, under war conditions, and went to its grave in the element in which it had rendered invaluable service. The original little "Wandle" created a record that has never been broken, of 72 voyages in twelve months. It may be stated here that since the inauguration of the service of bringing coals direct to Wandsworth by means of steam colliers, the Company has possessed at one time or another altogether some 13 ships, but with specially designed steamers with a larger carrying capacity the full coal requirements are met with a fleet of four vessels—the steamships "Wandle," "Tolworth," "Ewell," and "Woodcote."

Amalgamations in Brief.

1834. Wandsworth Company formed.
1835. Kingston Company formed.
Malden Company formed.
Dormay's Company (formed some time later).
1839. Epsom and Ewell Company formed.
1849. Mitcham Company formed.
1852. Wimbledon Company formed.
1857. Sutton Company formed.
1864. Mitcham Company amalgamated with Wimbledon Company.
1868. Kingston Company purchased Malden Gas-Works.
1873. Wandsworth Company purchased Dormay's Company.
1912. Wandsworth Company amalgamated with Mitcham and Wimbledon; and Epsom and Ewell Company.
1930. Wandsworth Company amalgamated with Kingston-on-Thames Company.
1931. Wandsworth Company amalgamated with Sutton Company.

Such is a bare outline, abstracted from a charming Centenary Brochure, of the Wandsworth Company's history.

Centenary Dinner.

The hundred years' service was happily celebrated on Friday last by a dinner at the Hotel Metropole, London. It was most unfortunate that the Chairman of the Company, Mr. Frank H. Jones, was unable, through indisposition, to be present. In his absence the guests were received by Dr. T. A. Ives Howell, Deputy-Chairman.

The Right Hon. The Lord Hyndley, who proposed the toast of "The Wandsworth and District Gas Company," having expressed the regret of all present at the absence of Mr. Jones, said that the Company might well be proud of its wonderful record. The Wandsworth and Putney Gas Light and Coke Company, Ltd., had developed, through a series of amalgamations, into a vast concern; and he suggested that much of its success was due to the greatness of Henry E. Jones. It was fortunate that he had been followed by another great man—Frank Harding Jones. Then, said Lord Hyndley, he was sure that the association of the Howell family with the Company had played an important part in its progress. It was now the third biggest Gas Company in London and the sixth in England; it was most efficient and progressive, and it was obvious that the management studied the staff. And in Mr. Croft the Company had a hard-working and loyal General Manager—a man who looked ahead. Lord Hyndley concluded by wishing the Company all success in its next hundred years' span.

Response to the toast was made by Dr. Howell, who mentioned that his grandfather was a member of the first Board of Directors of the Company, and since then there had been a continuous representation of the family on the Board. He thought they could justifiably look back with pride and pleasure on the work of the Company during the past century, and look forward with confidence to the future.

Mr. C. M. Croft proposed "The Visitors"—the only other toast—in most happy vein; and Sir Henry Jackson, M.A., M.B., M.P., in his reply, expressed his faith in the future of the Gas Industry.

Newcastle's Annual "Sale."

The practice of an Annual "Sale" is undoubtedly a valuable asset in gas appliance sales policy, as has been proved for many years by the Newcastle and Gateshead Gas Company.

At their thirteenth Annual "Sale" held in October the orders for gas-consuming appliances again exceeded those of the previous year, as also did the total cash value of the appliances.

The "Sale" is carried on at all showrooms of the Company for a period of two weeks. The Company do a big business under hire-purchase conditions, and a rebate of one, and in some cases two, quarterly payments is made on gas appliances installed under these terms. Bargains in good shop-soiled and reconditioned gas appliances are displayed on every hand and concessions are made on water heaters, wash boilers, &c. A 12½% cash discount is allowed on all new gas cookers and fires purchased. Special complete "Better-Lighting" offers are made of fittings and burners.

In addition to poster and press advertising, the Company publish and distribute some 45,000 copies of an attractive 16-page catalogue dealing entirely with the "Sale."

Orders for 3,700 gas-consuming appliances were secured, which, together with other items, brought the total to 10,400. Although an inducement of "free hire first quarter" was made for cookers and fires, it is interesting to note that 80% were sold as against the number taken on simple hire.

News In Brief

Second Prize in the trade tableau class was awarded to the Okehampton Gas Company for their entry in the recent local carnival.

Gas Companies' Protection Association.—The Thirty-Seventh Annual General Meeting of this Association will be held at the Caxton Hall, Westminster, at 2.30 p.m. on Monday, Nov. 12 next.

Applications are Invited by the Bristol Gas Company for the position of Assistant Engineer and Works Manager. The post carries a salary of £750 per annum. Further particulars will be found in our advertising columns.

Considerable Interest was shown in the recent exhibition of modern gas appliances, held by the Settle Gas Company, in conjunction with the Parkinson Stove Company. A series of cookery demonstrations held at the exhibition were also responsible for bringing in a good deal of business.

The Public Attendance at the Luton Gas Company's Centenary Exhibition, referred to in the "JOURNAL" last week, was 11,169. Sales were very successful, well over 300 gas cookers and 120 water heaters, coppers, &c., being ordered. In the cake-baking competition there were no fewer than 247 entries.

A Record for the District was created by the sales of gas appliances at a recent successful exhibition held by the Leyland Gas Company, on Oct. 15-19. A very pleasing feature was the high percentage of "new installation" appliances. Simultaneously, cookery demonstrations drew excellent attendances.

Symbolizing Germany To-Day in a film entitled "Germany Between Yesterday and To-Day"—a prize-winning film in the documentary class at the Film Congress at Venice this year—shown on Monday by the Film Society, were several "shots" of modern coke oven plant and also one of a waterless gasholder.

A New Company is reported by the Fuel Society of Japan to be in course of formation in Tokio, with a capital of £500,000 to establish works for the low-temperature carbonization of coal on the Yamato system at Sapporo in the Hokkaido. The plant will, it is stated, have a capacity of 300 tons of Japanese coal per day.

Two Electricity Failures occurred last week in the area of the Colne Valley Electric Supply Company—the one on Wednesday morning, which upset mid-day electrical cooking, and the other on Thursday night, when those without the convenience of a gas supply had to spend a considerable portion of the evening by candle light.

Meters, Ltd., of Manchester, announce the declaration of dividends for the current year: On the preference stock at the rate of 5½% per annum, and on the ordinary stock at the rate of 5% per annum. Dividend warrants will be posted on Nov. 14, and the transfer books will be closed from Oct. 29 to Nov. 8, both days inclusive.

The Gas Development Association for Women, Halifax Centre, have been invited by Mr. C. S. Shapley, on behalf of the Leeds Corporation Gas Department, to visit Leeds on Nov. 14, when a tour will be made of the workshops in Bridge Street. A short cookery demonstration will be held, and tea will be taken at the invitation of the Committee.

Gas Switches, it seems, are receiving much attention in Kent. At Canterbury, during the recent exhibition organized by the Canterbury Gas and Water Company, they were demonstrated with advantage. The Folkestone Gas and Coke Company are now running a special showroom display of switch-controlled lighting which is attracting much public attention.

The Anniversary Celebrations of the Blackpool Corporation Gas Department's Social Club proved very successful. The Wilson Cup for the best batting average at cricket was won by F. Greenwood and the bowling prize went to H. Johnson. The Wilson Tennis Cup will be held jointly by A. Dearden and W. Barrett. The Singleton Crystal Cup and replica in the Bowls Section were awarded to W. Dabbs.

An Address was given by Mr. J. E. Holliday, Engineer, Manager, and Secretary of the Otley Gas Company, to the local Rotary Club on Oct. 25. The address formed one of a series of vocational talks and dealt with the Gas Industry. Commenting on the foolishness of assertions that the Industry was a back number, Mr. Holliday said that gas remained to-day the most widely used illuminant and was being increasingly employed as a heating agent in the home.

Natural Gas in Japan.—According to a Return lately issued by the Japanese Department of Commerce and Industry, the output of natural gas during 1933 amounted to 16,561,900 c.ft. as compared with 18,096,800 c.ft. in the preceding year, a decrease of 1,534,900 c.ft., or about 9%.

All Ten Wickets of the Electricity Department XI. were taken in a cricket match this summer by Frank Slater, of the Blackburn Gas-Works team. In commemoration of this splendid feat he was presented last week by the Deputy Mayor, Alderman W. Kenyon, J.P., with the ball, suitably mounted and inscribed, at the annual gathering of the Gas Department Social and Benevolent Club, presided over by Councillor R. R. Fielding, Chairman of the Gas Committee.

Tenants without Light.—It was revealed at a meeting of the Stirling County Council Property and Buildings Committee on Friday, Oct. 26, that the tenants at Fankerton Housing Scheme, Denny, had been without proper lighting facilities for a year because the Scottish Midlands Electricity Supply Company, Ltd., could not reach an agreement with the proprietors whose land the overhead cables had to pass. The proprietors refused to allow the erection of wooden poles and insisted on steel ones. The difference in the price was £27, and the Committee agreed to authorize the payment of this sum in order to give the tenants the necessary lighting.

The Annual Dinner of the Sports and Social Club of the Parkinson Stove Company was held on Oct. 26, and was attended by some 200 members of the staff, representatives, and workpeople. Mr. W. Todd, Works Manager, presided, supported by Mr. R. J. Rogers, Managing Director, and other Directors of the Company. Mr. R. J. Rogers presented prizes won during the summer session, including the new Rogers Challenge Cup competed for by the Angling Section. A musical programme, to which the doyen of Parkinson representatives, Mr. L. Geo. Wilkes, who has completed forty-four years with the Company, contributed, concluded a most enjoyable evening.

The New Spiral Gasholder of the Accrington and District Gas Board was inaugurated by the veteran Chairman, Mr. John Barlow, J.P., on Oct. 25. It has a capacity of 390,000 c.ft. The ceremony was attended by Councillors from Church, Clayton-le-Moors, Great Harwood, Rishton, and Accrington. At the luncheon which followed the ceremony, Councillor R. I. Constantine, Deputy-Mayor of Accrington, said that the progress of the Board was mostly due to Mr. A. J. Harrison, the Engineer and Manager. They had installed 20,000 cooking and heating appliances at a cost of £125,000 and were still installing at the rate of 60 per week. Although they had spent £50,000 on improvements, for 15 years they had not raised one penny capital except for new mains.

Some Interesting Documents were recently discovered at Monmouth relating to the lighting of the Churches of St. Mary's and St. Thomas Overmonnow by the Monmouth Gas Company almost a century ago. Mr. Alfred Fowler, who was then Manager, made a sporting offer to the Vicar and churchwardens to light the churches by gas for the same cost as candles. So impressed were they by this offer that a committee was appointed to negotiate with Company. At a parish meeting held on Sept. 25, 1835, the proposal to install 32 lights in St. Mary's and 12 in St. Thomas Overmonnow was unanimously approved and the authority was given for the work to proceed provided that the cost did not exceed £30 a year. The installation proved so successful that subsequently additional lamps were fitted outside St. Mary's.

The Glenboig Union Fire-Clay Company, Ltd., show a trading profit for the year, before providing for depreciation, amounting to £394. After providing for Imperial Taxation and bad debts and adding the balance of £241 brought forward from last year, there remains at credit of profit and loss account the sum of £506. The Directors propose to accept, in respect of their services for the year, the modified sum of £400, which, being deducted, leaves a balance of £106 at credit of profit and loss account, which it is proposed to carry forward. In regard to depreciation, the Directors have transferred a sum of £1,500 from the reserve fund to meet this item. The ordinary capital expenditure during the year amounted to £3,277. The sum of £6,073 has been expended by the Company on repairs and renewals for the year, and has been paid out of revenue. The Directors are pleased to report a betterment in the affairs of the Company, the trading loss of £2,073 incurred in the preceding year having been converted into a trading profit of £394.

New Showrooms at Altrincham

OFFICIAL OPENING BY SIR EDWARD GRIGG, M.P.

New showrooms for the Altrincham Gas Company were opened on Oct. 24 by Sir Edward Grigg, K.C.M.G., K.C.V.O., D.S.O., M.C., M.P.

Prior to 1919 the Company had no showrooms worthy of the name, a few cookers in a disused office representing this side of the business. In that year, however, showrooms were erected, which served until the present time. With the large increase in the population of recent years, and the more extended use of gas, it was found that these premises were not large enough to display adequately the many labour-saving devices which the Company now offers to its consumers. Steps were therefore taken, in 1933, to build larger and more convenient showrooms, and at the same time to increase the office accommodation, which had been outgrown. For some time the Company had owned the site adjoining the offices, and it was decided to utilize this, on the lease lapsing last year.

The design of the new building was entrusted to Mr. J. Cocker, A.R.I.B.A., and Mr. T. H. Hill, A.R.I.B.A., and on their suggestion the Directors decided to demolish the existing building on the site and erect a completely new showroom.

This building, designed on plain lines and in keeping with the existing offices, consists of a steel framed structure, carried up from the basement level of the old building. The external walls are of mellow-toned brickwork, the lower portion being faced with terrazzo slabs as surrounds to the windows. The floors, each of which has an area of 1,600 sq. ft., are of fireproof construction, that of the demonstration room upstairs carrying flues for ventilating the showroom below. A notable feature of the building is the large expanse of glass in the showroom windows. The panelled oak screens at the back of the windows are arranged as gas-fire settings and are removable should it be desired to increase the window space for displays. The entrance consists of two double doors, with a canopy, the whole being in bronze.

The whole of the interior is panelled in oak, and a broad oak staircase connects the two floors.

The building is lighted by means of ventilating lamps which maintain a constant change of air, each lamp being connected to a ventilating flue. All the lamps are controlled by means of conveniently placed switches. The outside lighting is arranged for operation by means of a clock, so that the lamps are lighted and extinguished automatically. They are kept alight until late in the evening for advertising purposes.

At one end of the showroom is the counter for the payment of accounts, and behind this the rental office. Offices are also included here for the Showroom Manager and his staff.

The large room above is to be utilized as a demonstration room, where lectures on cooking, laundry, and other subjects can be given in comfortable surroundings. It will seat 250 persons. It is also used for the display of a selection of hot water apparatus in actual use, which it is hoped will be a very useful feature.

Adjoining the demonstration room is the new Board Room, Secretary's Office, and other offices.

The heating of the building is by hot water radiators, the boilers for which may be heated by gas or coke.

Amalgamation and Grouping.

The Leadenhall Investment and Finance Company.

The Leadenhall Investment and Finance Company, London, are offering to purchase the shares of over a dozen gas companies in Fife.

Last week a meeting was held in Cupar of Directors, secretaries, and managers of the companies which have been approached. Representatives were present from the following towns: Lochgelly, Kelty, Cardenden, Pittenweem, Anstruther, Kinross, Elie, Crail, Cupar, St. Andrews, and Markinch. Hon. Sheriff Stark, Chairman of the Cupar Undertaking, was in the chair and the majority were definitely against selling.

It was remitted to Treasurer Bruce, St. Andrews, to draw up a scheme of mutual assistance in cases of difficulty.

South-Western Gas Corporation, Ltd.

Close Brothers, Ltd., announced on Oct. 27, that the offers made by the South-Western Gas Corporation, Ltd., to the preference and ordinary shareholders of the Dorchester Gas and Coke Company, Ltd., and the ordinary shareholders of the Wotton-under-Edge and District Gas Company, Ltd., respectively, have been accepted by holders of over 91% of the preference shares and of over 95% of the ordinary shares of the Dorchester Gas and Coke Company, Ltd., and by holders of over 97½% of the ordinary shares of the Wotton-under-Edge and District Gas Company, Ltd.

Australian Gas Congress.

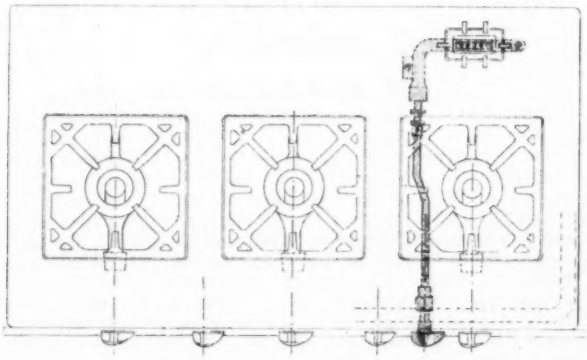
The Institution of Gas Engineers has sent the following telegram to Mr. P. C. Holmes Hunt, Hon.M.Inst.Gas E., Chairman of the Australian Gas Congress, which opened in Melbourne yesterday and will terminate to-morrow, in conjunction with the Victorian Centenary Celebrations attended by H.R.H. the Duke of Gloucester:

> "Council greatly appreciates but regrets its inability to accept cordial invitation to Australian Gas Congress for success of which and continued prosperity of Australian colleagues the Institution of Gas Engineers sends its sincere good wishes.—ALEXANDER."

Special Burners for Irons.

An Adjunct to the Gas Cooker.

An employee of the Antwerpsche Gasmaalschappij recently put forward a novel suggestion for the equipping of gas cookers with a special burner for hollow irons, details of which the General Manager of that Company (Mr. E. F. Dadson) has been kind enough to furnish.



A special 5-hole burner for the irons is inserted at the back of the right-hand boiling ring and is placed at right-angles to the back of the hotplate so that the handle of the iron points to the right. The accompanying drawing makes the arrangement clear.

Mr. Dadson tells us that, in response to his request, the Belgian Gas Association passed on the suggestion to local manufacturers, who are already supplying models to the public, with whom the idea appears to be proving popular.

A New Gas Water Circulator.

The water circulator here illustrated is a development of the Leicester Gas Department and was evolved with the definite aim of competition with the electric immersion heater. It is highly efficient, and will deliver hot water at every hot tap in the house. The heater is simple, economical, and easily maintained, and builders are fixing these on housing estates in preference to the usual back boiler.

Stop Watches for the Laboratory.

Those concerned with laboratory experiments and general research work have frequently occasion to enlist the services of stop watches for their assistance. Some new mechanisms recently introduced by Messrs. A. Arnold & Co., of 122, St. John Street, Clerkenwell Road, E.C. 1, may therefore be of interest to the Industry.

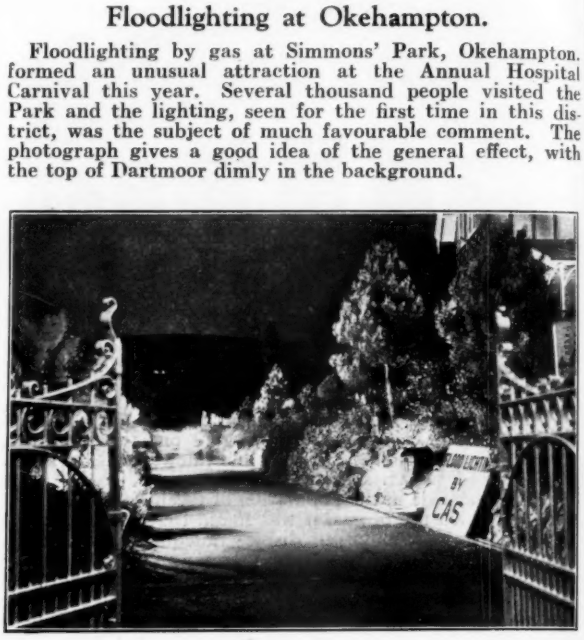
The Arnolds " Universal " racing recorder has a number of outstanding features. The 60-minute recording dial has a 45-minute section indicated in red; in addition to the main press-down control to set the watch going there is also a side eliminator with which the watch can be stopped at any time and restarted from that point without bringing the hand back to zero. The movement is a high-grade mechanism fitted into a highly finished chromium-plated case with an unbreakable glass.

Another new model is the " Chronograph " independent fly-back stop-watch, which has several new and improved features. It provides the ordinary timepiece with an independent second hand and 30-minute recording dial. It is calibrated in $\frac{1}{5}$th seconds, and this watch can be used as a pocket watch or as a stop-watch, the mechanism being very reliable and carried in a flat dress-type engraved chromium case.

A watch of value to those who wish to leave a particular experiment for a certain time and get on with other work is the firm's " Programme " watch. Although this alarm watch is not appreciably larger than an ordinary modern watch, it gives a sufficiently loud and clear call, and the alarm is easily set by rotating the bezel. Power for the time-keeping mechanism and for the alarm bell is supplied by the same spring, and so the operation of winding is carried out by a single stem winder, which is a convenience.

Floodlighting at Okehampton.

Floodlighting by gas at Simmons' Park, Okehampton, formed an unusual attraction at the Annual Hospital Carnival this year. Several thousand people visited the Park and the lighting, seen for the first time in this district, was the subject of much favourable comment. The photograph gives a good idea of the general effect, with the top of Dartmoor dimly in the background.



The lighting was carried out by means of nineteen Parkinson 10-light horizontal and upward beam strip lanterns supplied through 1¼-in. pipe and short lengths of ½-in. hose. The arrangements were in the hands of the newly-appointed Manager, Mr. J. C. Cotterill, and the staff of the Okehampton Gas Company, Ltd., with the kind assistance of Mr. E. E. Jones, of W. Parkinson & Co.

Centenary Celebrations at Bury St. Edmunds.

A review of the progress of the Gas Company in Bury St. Edmunds during the last 100 years was given at the centenary celebrations of the Company on Oct. 16, when a large company was entertained to luncheon in the town's historic Guildhall by the Directors.

It was in 1834 that gas came to the borough. In January of that year, Messrs. John Malam (of Hull) and T. S. Peckston entered into a contract with the Borough Paving Commissioners to erect a gas-works and to supply gas for public and private use. The following January a syndicate called the Bury St. Edmunds Gas Light Company bought the concern for £6,000 in cash and a like amount in fully-paid shares in the new company. In 1849 Mr. Robert Bevan (of Oakes, Bevan, & Co.'s Bank), who now had a controlling interest in the Company, disposed of the entire Undertaking to a new organization incorporated by the Bury St. Edmunds Gas Act, 1849. The purchase price was £8,500, and the name of the new owners was the Bury St. Edmunds Gas Company.

In 1857 a telescopic gasholder was erected at a cost of £950, a holder tank costing £619. Further extensions to the works were put in hand in 1860, while in 1876 a new gasholder and purifier were erected. A new retort house was built the following year. In 1878 the capital of the Company was increased, the new capital being sold to the public at a premium of not less than £2 17s. 6d. per £100 of stock. In 1920 two purifiers were erected at a cost of £3,005, and it was decided to install a plant for the manufacture of sulphate of ammonia. Plant for tar preparation was also installed about the same time. In 1926 it was resolved to adhere to the horizontal system of retorts, but with the addition of charging machinery. The modernization of the works, which is still proceeding, included a new retort house and carbonizing plant, coke, breaking and storage plant, a gas engine for power generation, the replacement of the old tar preparation plant by an up-to-date system, and the erection of a new gasholder with a storage capacity of 150,000 c.ft. Finally, a site was purchased for the showrooms.

The progress is further emphasized by the fact that the

output of gas and the number of consumers have increased year by year until the last available statistics show a total annual output of no less than 96,780,000 c.ft. The number of consumers is now 3,595. In the last twenty years the output of gas has increased by 58%, and the number of consumers has more than doubled. The distribution of gas over the area of supply is through 22 miles of mains.

A Great Future.

The Chairman of the Directors (Ald. J. Ridley Hooper) presided at the luncheon, and the Mayor (Ald. E. L. D. Lake), Chairman of the Borough Electricity Supply Committee, replying to the toast of "Our Guests," said he was convinced there was as great a future for gas as there was for electricity.

Responding to the toast of "The Gas Industry," proposed by Captain F. F. A. Heilgers, M.P., Sir Francis Goodenough, Chairman of the British Commercial Gas Association, said that the number of gas appliances sold in the last twelve months was a record. They were now endeavouring to sell their goods, and not waiting for the public to come and take them.

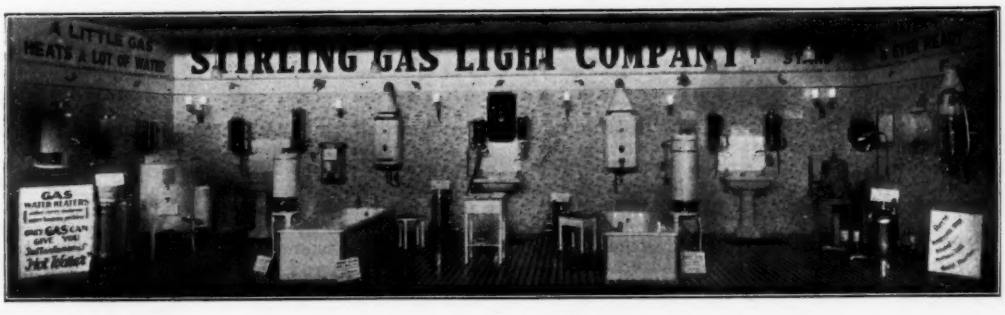
Mr. W. Ross Taylor, M.P., representing the National Gas Council, who also responded, said that the present Parliament was more "gas-minded" than any of its predecessors. Unfortunately the legislation under which the Gas Industry laboured had not moved *pari passu* with the developments which had taken place in the Industry itself, and they hoped very much that the Government of the day would realize it was important that gas should be free from the shackles which at present were hindering its progress. He was well convinced that gas was on the threshold of great development.

Sir Richard Winfrey proposed "The Bury St. Edmunds Gas Company," remarking that the progress of the Company had kept pace with the general increase throughout the country. He thought that more companies might follow the example of gas companies in adopting the principle of co-partnership, which certainly led to more peace in industry.

Mr. Charles Best, one of the Directors, who replied, read a message from Mr. Alex. Mitchell, their Vice-Chairman, who has devoted 53 years of his life to the service of the Company. Improvements at the works and in the mains had been made, said Mr. Best, so that for all time they would be equal to the growth of Bury St. Edmunds.

Gas Exhibition at Stirling

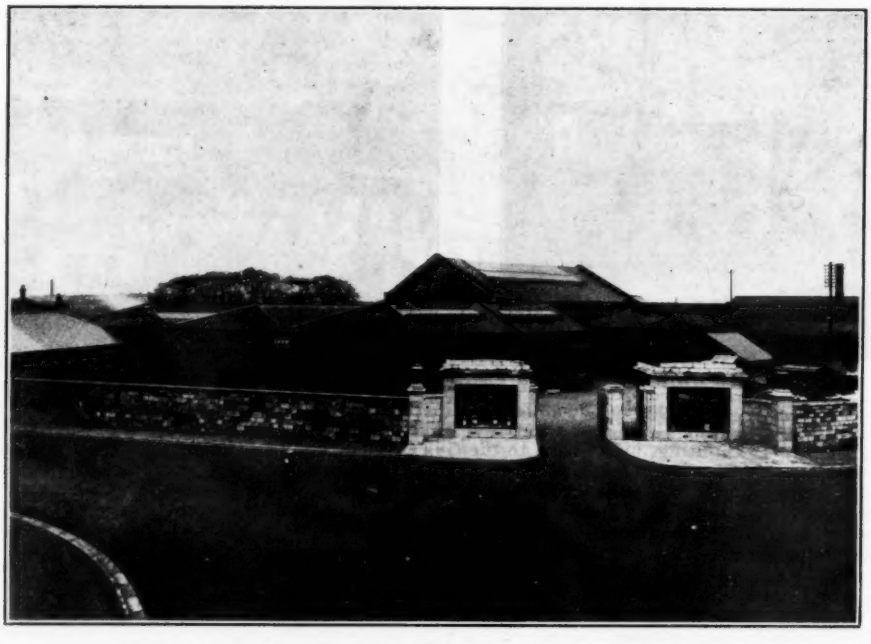
Attracted by the pleasing effect of the gas floodlighted Aibert Hall, Stirling, large numbers visited the exhibition held there recently by the Stirling Gas Light Company. The Chairman of the Company declared the exhibition open, and among the firms exhibiting, in addition to the Gas Company's own display, were the Parkinson Stove Company, Ltd., John Wright & Co., Ltd., R. & A. Main, Ltd., the Horstmann Gear Company, the Economic Washing Machine Company, together with a stand devoted to Vitreosil products. An impressive general view of the exhibition hall is given in the right-hand photograph above, while the other photograph above is of the recently completed vertical retort house at the Stirling Gas-Works, also floodlighted by gas in connection with the exhibition. The floodlighting units were supplied by Messrs. William Sugg & Co., Ltd. Below is the Company's hot water display at the Exhibition.



Developments at Lincoln

Inauguration of New Distribution Centre

ORIGINAL COAL STORE NOW MAIN STORES.



GENERAL VIEW OF NEW DISTRIBUTION CENTRE.

Lincoln Corporation Gas Department's new distribution centre at Newland was officially declared open by the Mayor of Lincoln (Councillor G. Deer) on Oct. 23. The ceremony marked another step in the development of the Department which has made rapid strides in the last few years.

The distribution centre was formerly the Newland Gas-Works, which were rendered redundant by the erection of the modern plant at Bracebridge. The old buildings have been splendidly adapted to serve their new purpose, and the Department has thus acquired really valuable premises at a very low cost.

The widening of the street in front of the centre has given a fine approach to the site. The original retort house has been turned into motor garages and a yard, and the old coal store has become the main stores. The store for gas fires and appliances is accommodated in the original blacksmith's shop, the stores office is housed in what was the

old boiler house, and the original purifying house is now the cooker renovation department.

In the presence of a large company, consisting for the greater part of men connected with the Gas Industry, which had assembled at the entrances, the Chairman of the Gas Committee, Councillor A. L. Bower, asked the Mayor to open the gates.

This ceremony having been performed, the civic party, accompanied by other distinguished visitors and members of the general public, gathered in front of a platform erected in the yard.

Councillor Bower said that the Gas Committee had put the production side on modern lines, the distribution centre in a position to cope with increasing business, and had then turned their attention to the selling of appliances.

Increased Sales.

The showroom sales in 1930 amounted to £7,000, and, for the first six months of this year, have already reached £22,000. Since Easter over 2,500 cookers have been sold. The increase in gas made in the last four years was over 53,000,000 c.ft., and the amount of bye-products increased proportionately.

In connection with the alteration to the premises the Department had made a present of the land to the highways department which had enabled them to make a splendid road improvement.

"Any of you passing this corner after dark," said Councillor Bower, "will notice that the centre street lamp gives a better light than usual. This is because it is the first lamp in Lincoln to be lit by high-pressure gas. We are hoping that it will be possible to put more high-pressure gas lamps on the streets in Lincoln. You will also notice that the first street island bollards are also illuminated by gas."

Councillor Bower concluded with a tribute to the Engineer and Manager (Mr. George Wright), who had been the moving spirit behind their schemes, and to whom the advance made by the Department was chiefly due.

The Lighting of Liverpool.

The following is an extract from the report of the City of Liverpool Lighting Engineer's Department on the work of the Department for the year ended March 31, 1934.

The length of streets, courts, and passages lighted at the end of the year amounted to 903 miles, which is an increase of 10¾ miles over the previous year's figures. The mileage is made up as follows:

Gas	649½
Electric	253¾

The price of gas for street lighting remains as hitherto—viz., 7·4d. per therm less 20%, or 2s. 4·12d. net per 1,000 c.ft. when the consumption is 850,000 therms or 178,925,000 c.ft. and upwards per annum.

During the past year the consumption amounted to 931,862 therms (196,181,438 c.ft.), as against 950,054 therms (200,011,590 c.ft.) the previous year, while the total charge for gas consumed for street lighting purposes amounted to £22,985 18s. 4d., as against £23,434 13s. 5d. the previous year. The total number of gas mantles used during the year was 91,396, equalling an average of 3·55 per burner per annum, as against 3·26 for the previous year.

The use of reinforced concrete lamp columns and lighting poles in lieu of cast iron columns and steel lighting poles having been generally adopted, there have, during the year, been 374 of the former erected, making a total of 990, and 15 of the latter, making a total of 206.

The installation and subsequent maintenance, now chiefly the latter, of gas burners, fires, cookers, and other gas-heated apparatus in the various public buildings, schools, &c., have continued, in addition to which 1,028 private street and staircase lamps, 4 island bollards, 436 danger posts on tramway tracks, 523 tramway stop signs, 72 traffic diversion signs, and 10 junctions fitted with automatic traffic signals are also maintained, and the revenue received from this work amounted to £7,350 15s., as against £8,363 0s. 6d. the previous year.

Smith Meters, Ltd., Staff Dinner and Dance

On Oct. 26 the staff of Smith Meters, Ltd., held a dinner and dance at the Park Lane Hotel. It was their usual annual function, but being the Centenary year of the Company it was decided to entertain the Directors and their friends.

About 140 sat down to dinner under the Chairmanship of Mr. S. E. Cash (Chairman of United Gas Industries, Ltd., and Director of Smith Meters, Ltd.), and the gathering was an exceptionally happy one, marked by excellent speeches and presentations from the staff to the brothers who have built up such a successful meter business.

The presentations were almost identical, in each case taking the form of Old English Silver Fruit Centre-Pieces, and beautifully bound Auto Albums, containing Illuminated Addresses and Photographs of the Staff members of the various branches of the Company.

In acknowledging the gifts, Mr. E. W. Smith (Chairman, Smith Meters) spoke of the excellent feeling shown by such handsome presents. The liberal manner in which they had been entertained that evening proved beyond doubt that Smith Meters moved forward as a whole concrete body. He also wished to place on record the fact that on such a happy occasion—it being their Centenary Year—their thoughts and gratitude should go back to their forebears, W. Smith and G. Smith, pioneers in the, then, new world of meter engineering, who laid such sure foundations of reliable products upon which to build, making their present position possible.

Mr. Lewis Smith (Secretary and Director), in acknowledging the gifts, said that a happy and contented staff, and good and efficient workmen, ensured the production of excellent meters. Again referring to the generosity of his Staff in organizing the gathering, Mr. Smith remarked that if only such feeling could be introduced into all branches of industry, it would be the better for the whole country.

Modern Legislation for the Gas Industry

By George Evetts, M.Inst.C.E., M.Cons.E.

No. 2

THE Author continues his review summarizing the position of legislation up to the present time as it affects the Gas Industry to-day. Mr. Evetts' first article in this series appeared last week.

Provision for Maintenance, Repair, and Obsolescence.

Powers in Respect of Legislation.

As already mentioned, the statutory position with regard to these matters will be considered in conjunction with the usual Company procedure and the permissible allowances from the Income Tax Authorities. It is clear that special legislation is not necessary for the allocation of revenues to the normal maintenance of the undertaking. One would not expect references to this in the special Act of Parliament any more than one would expect to find power to purchase the necessary stationery and pay the necessary wages for the manufacture and distribution of gas. In addition to such expense, however, Parliament has considered it necessary to legislate not only for enabling purposes, but also for the purpose of limitation. The relevant powers and limitations come under three headings.

1. The Renewals Fund.

The use of this is clear. It is a measure for the equalization of expenditure on the upkeep of the works and plant. It is to be applied to maintenance and renewal, and is not to be used in "the replacement or removal of plant or works." It is somewhat difficult to analyze the difference between the terms "renewal" and "replacement," but it is usually understood that replacement involves putting the same piece of plant on a different site—*i.e.*, replacement is merely another word for "removal." Reference is often made to distribution "plant," but the use of the reserve fund is not usually accepted as being extended to mains. According to the 1934 Act, references to Capital in Clauses relating to Renewals Fund are applied to share capital *plus* premiums, *plus* borrowing on mortgage or by the issue of debenture stock. Debenture stock which has been once issued and paid off is of course not included. The usual allocation to the Renewals Fund is ½% per annum with a total of 5%, but under the 1934 Act application can be made to the Board of Trade by undertakings not selling more than 5 million therms, to have this figure increased to 7½%. In the absence of a fund already built up, this amount is not extravagant either in the annual amount or in the total, but it must not be overlooked that it is in addition to the actual expenditure allocated to the revenue account of the year. In addition, there seems to be no statutory ruling against the placing of sums to suspense, *i.e.*, to carry what is in effect a temporary Renewals Fund. If, for instance, an undertaking has an expenditure of £10,000 contracted for in any one year (say 1935) for which contracts are made, it would not be unreasonable or contrary to the Statute to earmark, say, £2,000 in the 1934 accounts to a contingency, in the event of there being insufficient sums in the Renewals Fund to meet the expenditure. Then, in 1935, if the Company could afford £4,000 from the revenue account towards the expenditure, this makes £6,000, leaving £4,000 balance which could be put in suspense and paid for during 1936, and possibly 1937 as well. There seems to be no statutory or moral reason why such definite expenditure should not be dealt with outside a fund and the fund regarded as being built up for unforeseen or future renewals.

2. Special Purposes Fund.

This is usually authorized at 1% of the paid up capital with a maximum accumulation of 10%, and under the 1929 Act the Capital is described as being share capital *plus* premiums, *plus* loans (on mortgage or by means of debenture stock), exactly as in the case of the Renewals Fund above referred to. In certain circumstances the Special Purposes Fund can be used to cover the wastage of plant, particularly in case of accident or unforeseen circumstances, or when the replacement or removal of plant or works is involved. The wording of the Special Purposes Fund Clause, however, makes it clear that it is not to be used for the maintenance and renewal of plant and works. This last mentioned is purely the function of the ordinary expenditure or the Renewal Fund proper.

3. Obsolescence.

If any special circumstances arise, Parliament or the Board of Trade are always ready to grant facilities for the amortization of plant or buildings through the revenue account. For example, in the case of amalgamations, it may be the intention to supply from a central works and shut down subsidiaries. Alternatively, arrangements may be made for the purchase of gas in bulk from coke ovens or elsewhere, thus involving the shutting down of works. A further example is where new works are built and old works shut down without either amalgamation or purchase in bulk. In extreme cases, it can be proved that the original capitalization of an Undertaking has been excessive. In all these cases, Parliament or the Board of Trade have enabled capital to be reduced by amortization out of revenue, and in more than one case power has been given actually to redeem the capital. This last mentioned course, however, seems to be unnecessary, because a double process is involved of:

(*a*) Redeeming capital.
(*b*) Re-issuing capital for future development.

It is preferable, therefore, to amortize the capital expenditure out of revenue without actually redeeming the capital, and use the funds so freed for future development.

Arrangement with Income Tax Authorities.

So much for the powers in respect of gas legislation. In addition to these powers, the arrangements with the Income Tax Authorities enable Gas Undertakings to depreciate such items as gasholders, motor vehicles, meters, stoves, and other appliances, and charge to revenue new service pipes, internal carcassing, and prepayment lighting fittings in the year in which such expense is entailed. In fact, the agreement with the Income Tax Authorities goes farther than this. It enables an Undertaking which may charge services, &c., to capital to write these back to revenue for the purposes of assessment for income tax. There are no special clauses in gas legislation dealing with such allowances, but Parliament or the Board of Trade has never raised any objection to the principle that it is fair to charge to revenue the depreciation permitted by the Income Tax Authorities. The question as to whether new services, carcassing, &c., should be a revenue charge has not, to the writer's knowledge, been prominently before the Authorities at the time when powers have been sought, but this must naturally be a question of the financial position of the Undertaking in question, the price of gas, and many other conditions. It is to be noted, however, that whereas gas legislation prevents the allocation to *funds* other than those specified above, there is no embargo on the allocation to revenue of the items specified in the agreement with the Income Tax Authorities. Depreciation other than on items mentioned is not permitted by the Income Tax Authorities, nor is it favoured by the Board of Trade. In view of the adequacy of the provisions

enumerated, there is no hardship in this, but the writer is of the opinion that it would be desirable to amalgamate some provision for mains on the lines of the Renewal Fund for the works and plant. The mains are largely unseen. The value is very large and considerable expenditure on renewals might arise in one year. It would appear desirable to equalize this expenditure by doubling the permissible amount of the Renewal Fund both in annual allocation and in total. Over a period of years this would not increase the cost of gas to the consumer, but it would tend to equalize annual expenditure.

The Income Tax Authorities are now reasonable in regard to obsolescence. If a new building or a new piece of plant takes the place of an old one, then 100% of the new cost is allowed as a charge to revenue, but if the replaced article has a larger capacity, then a proportion is allowed for revenue. Further, the replaced item of plant need not be of the same nature as the old. Thus, if a carbonizing plant is shut down and a trunk main laid in its place, then obsolescence is allowed on the old plant provided the Income Tax Authorities can be satisfied that the old plant has not been previously written off the books or acquired at no expenditure.

In respect of dealing with these obsolescence claims for substituted type of plant there are two weaknesses:

1. Buildings are not allowed unless they are mere shells for the plant and are destroyed with the plant. Presumably this is on the principle that the hereditament is not destroyed but only the process machinery, and that the building is available for further use.

2. There is a tendency by many inspectors in the case of amalgamation or purchase of outside undertakings to reduce the value of the works put out of operation, and so reduce the claim for obsolescence. It is argued that the absorbing Undertaking pays a large amount for the goodwill and the distribution plant, and that in fact very little of the purchase price is attributable to the works. This argument should be strenuously contested. It is an important point of principle, and it can be argued that the only element of goodwill is the excess amount paid over and above the real value of the structural assets. That is to say, if the earning capacity justifies a higher price than a reasonable valuation of the assets, then this can fairly be attributed to goodwill. On the other hand, the purchasing undertaking has to buy the works, whether it intends to use those works or not, and if the inspector's arguments are sound, it would lead to the conclusion that the works really are valueless if the purchasing undertaking intends to shut them down.

There is one further allowance under the Income Tax Acts which can be claimed in connection with the works, and that is in regard to Section 18 of the Finance Act, 1919—the well known one-sixth annual value allowance. This is an allowance over and above the actual expenditure entailed on the repair and maintenance of the works, but does not include gasholders, seeing that depreciation is already allowed on these under a separate agreement. It is therefore necessary to prepare a structural valuation of the hereditament. The annual value is then estimated to be 5% of this capital valuation, and the allowance is one-sixth of this. This allowance was primarily intended to cover mills and factories which were subject to vibration by the operation of process machinery in mills, &c., and its provisions were later extended to gas-works. Apart from gasholders, one would eliminate from this structural valuation any of the tenant's chattels, and also offices, &c., leaving the valuation to cover the remaining part of the landlord's property.

With regard to items which are allowed, naturally the practice varies, but in general one can include retort houses, charging machinery, coal and coke plant, stores, &c., which are attached to the retort house under one continuous roof; purifiers and structures included in the purifier shed, oxide shed, oxide handling machinery, &c., together with exhausters, boilers, mechanical washing and scrubbing plant, generating plant, and the corresponding buildings.

This completes the subject matter under this heading, and it will be seen that, in conjunction with the regular maintenance of the Undertaking, the allowances permitted by the Income Tax Authorities and the Gas Statutes are many and varied, and, with the single exception referred to, cover the whole field adequately.

In order to summarize this section, it would be useful to outline the typical case of an undertaking selling 500 million c.ft. per annum—say, 2½ million therms.

Typical Case.

Sale of gas—			
500 million c.ft. per annum		= 2,500,000 therms	
Total capital expenditure		= £300,000	
Working capital—say		20,000	
Total capital and loans raised		£320,000	
Consumers, 17,000. Additions in one year.		= 850	
Dissection of capital—			
Works subject to allowance under Section 18 of Finance Act, 1919	£70,000		
Works *not* subject to allowance under Section 18 of Finance Act, 1919 (excluding gasholders)	42,000		
Gasholders (written down value)	25,000		
		£137,000	
Mains and services		95,000	
Meters (written down value)		22,000	
Stoves and appliances (written down value)		27,000	
Prepayment piping and fittings		9,000	
Sundries		10,000	
		£300,000	

Total Allocation to Repairs and Maintenance.

	£	£		d. per Therm Sold.
R. & M. works—Actual expenditure	11,600			
,, ,, Renewal fund, ½% on £320,000	1,600			
,, ,, ½th annual value of £3,500	583			
,, ,, G.H. depreciation, 3½%	825			
		14,608	..	1·41
R. & M. mains and services general	3,500			
Renewals—Mains	1,000			
,, Services	1,000			
		5,500	..	0·53
New services—850 at £2 15s.		2,338	..	0·22
R. & M. meters—Ordinary and P.P.	1,750			
Depreciation— ,, 11%	2,420			
		4,170	..	0·40
R. & M. stoves—Ordinary and P.P.	3,750			
Depreciation— ,, 11%	2,970			
		6,720	..	0·65
R. & M. prepayment installations	2,000			
New p.p. fittings and carcassing—440 at £2 5s.	990			
		2,990	..	0·29
		£36,326	..	3·49

The figures show the amount allowed by the Income Tax Authorities and either allowed or not disallowed by Statute. One qualification is needed, however; the renewal fund item will be written back to profits for each year it is charged in the revenue account, but allowed when it is taken from the fund—*i.e.*, it is allowed as and when the fund is made use of.

It is noted that the renewal fund allocation amounts to £1,600 per annum. If a sinking fund basis were adopted as an alternative, and taking a 3½% table with a 30-year life for the plant coming under the scope of the Finance Act, 1919, and 50 years for the balance, we should get:

£70,000 × 1·94%	= £1,358
£42,000 × 0·76 ,,	= 321
	£1,679

On a systematic renewal basis—*i.e.*, meeting the renewals as they arise as far as possible, and taking 37½ years as the average life, we get a sum of £2,980 a year, but it must not be overlooked that the renewals of many small parts are already included in the sum of £11,500 per annum.

Summing up, the position is satisfactory, because very few undertakings can afford more than the permissible amounts outlined in the previous table.

Powers of Charge, Tariffs, and Effect on Dividends.

Up till recently freedom in making tariffs was very limited, not so much in theory as in practice. Special tariffs had to be framed with strict regard to the effect of dividend limitations, but municipal undertakings had more freedom seeing that they are maximum priced undertakings mostly with a considerable margin.

It was not until the passing of the Gas-Works Clauses Act in 1871 that the consumer had a right to demand a supply. By Section 11 of that Act, any prospective consumer can demand a supply of gas provided he is within 25 yards of a main, and this supply can be made the subject of a contract in so far as the undertakers can demand revenue equal to 20% on the cost of the main laid for the particular consumer, for a period of two years. Further, the undertakers can demand security for the payment of these dues before the main is laid, and there is a further proviso in the Section which enables undertakers to obtain

security from any consumer after the commencement of supply, and in the event of one security not proving satisfactory, another can be demanded in substitution. This contract, however, is of a different nature from the general power to make contracts which was conferred upon undertakers under Section 13 of the Act of 1847. In this Section the undertaker could make any contract with a prospective consumer, and it is presumed that such contract could include price, load factor, periods of taking supply, maximum and minimum requirements, or any other condition which might be mutually agreed. The contract could be made for the supply of gas *plus* service; the undertakers could, within the ambit of the contract, supply pipes, burners, meters, lamps, and the maintenance thereof.

At a later stage Companies obtained general powers in Acts or Orders to supply other gas-consuming appliances and gas engines, and therefore the effect of this Clause became extended to such articles. In fact it was not uncommon to find a Gas Company supplying and fixing a gas engine for a customer and supplying gas for a period of years at a certain price, including the maintenance of the engine. At a later stage the consumer obtained protection against inequitable treatment on the part of the Company by the introduction of the "equality" Clause. The majority of Undertakings obtaining fresh Acts or Orders which incorporated the 1847 Act had the proviso incorporated stating that all such contracts should be alike in terms and amount to all consumers for supply in "like circumstances and for the same purposes." This amendment is now automatically applied to all undertakings by Section 6, Subsection (1) (*b*) of the Gas Undertakings Act of 1934. The position is further clarified in this Section by adding the words "or any premises" after the words "private building." These words had usually been added to private Acts or Orders in the same manner as the "equality" proviso.

A further important addition is in respect of gas supplied through prepayment meters. By Subsection (2) of Section 6 of the 1934 Act, the fact is stressed that gas as gas must be sold at the same price to ordinary and slot consumers alike, and that the surcharge is to be regarded strictly as services rendered other than the supply of gas.

The Subsection emphasizes the effect of the "equality" clause by stating that the supply of gas through a prepayment meter as compared with an ordinary meter shall not be deemed to be different circumstances simply on account of the differences between the meters. Subsection (3) provides that Section 13 of the 1847 Act as amended shall apply to any enactment whether passed before or after the 1934 Act, and any other amendments of the Section shall cease to have effect. There is a final proviso to the effect that the amendment shall not apply to contracts made before the commencement of the Act. In other words, existing contracts are not affected.

The important part of this Section is the term "like circumstances." As far as the writer is aware, it has never been fully thrashed out what constitutes "like circumstances," or, what is equally important, "different circumstances." The most vexed question in this respect is whether use in different trades constitutes different circumstances. For example, an undertaking may give a discount to fish fryers or create a special tariff and give a different discount or frame a different tariff for gas engines. It may be argued that this is because the loads are of a different nature, but this appears to be a mere quibble, since the gas engine may be used in exactly the same hours and at exactly the same maximum loads as the fish fryer, and yet the prices may be different. Looked at from the economic point of view, it is possible to imagine a fish frying load and a gas engine load absolutely identical as a gas supplying proposition, and yet carrying different prices. It would be very difficult to justify on economic grounds varying tariffs based on the purposes of use. It is clear, however, that the purposes of use must enter into the political discussion on tariffs. An undertaking may be able to get fish frying business at "x" pence per therm, whereas to get a gas engine load the price must be below "x." Even at the lower price the gas engine business may show a profit. Is the Undertaking to refuse such business owing to the existence of the "equality" clause?

To follow the matter up logically, however, if the answer is that the business should be accepted, then the anomaly is created that the similar load—viz., fish frying—carries a bigger margin of profit, and this is contrary to the spirit of the "equality" clause. Nobody would argue, however, that it is against the law to make these different rates for different trades. "In the like circumstances and for the same purpose" indicates that in similar trades the prices must be same, other things being equal, and this might be held to imply that in a different trade, or for a different use, the price can vary, although circumstances for the two purposes may be alike. The words quoted are very wide, and it is not intended that the underlying principle is that every consumer should pay his economic price. If this were so, the ordinary consumer living next door to the gas-works could claim gas at a lower price than a consumer five miles away, because he could produce a perfect economic argument that his "circumstances" are different. It would appear sufficient that every fish fryer taking the same quantity of gas with the same load factor should be treated the same, and the "equality" clause could not be expected to go further than this.

It is to be noted that although Subsection (2) differentiates between gas through slot and ordinary meters, no differentiation is laid down in respect of differential price areas. This would be a difficult point to legislate upon. The differential price is in theory the extra average cost of supply. The actual extra cost of supplying a large industrial consumer in an outer area may be trifling, and therefore it would appear that the spirit and the letter of the "equality" clause is not being broken by supplying industrial consumers in an outer area at a price very little higher than a similar consumer in the principal area.

[With this introductory consideration of the question of contracts, Mr. Evetts will discuss Tariffs in his next article.]

Industrial Co-Partnership Association.

Meeting at Watford Gas Showrooms.

A former Minister of Labour, Sir Montague Barlow, Bt., K.B.E., was one of several who spoke in favour of co-partnership, at a conference convened by the Industrial Co-Partnership Association and held at the showrooms of the Watford and St. Albans Gas Company last week.

Mr. R. T. Kent, a Director of Watford and St. Albans Company, was in the chair, and there were present representatives of firms from Watford, Rickmansworth, Apsley, King's Langley, Chesham, Berkhamsted, Wandsworth, and Wokingham.

Mr. Kent referred to the absence through illness of Mr. F. H. Jones (Chairman and Managing Director of the Company) who was to have taken the chair. Mr. Jones, he said, was a very great supporter of co-partnership.

Mr. Kent referred to the success of the co-partnership scheme of the Watford and St. Albans Gas Company which was started 25 years ago.

Sir Montague Barlow said the Gas Industry had a splendid record in such schemes. They had given a real lead. But they had certain definite advantages which had enabled them to do so.

The real object of the schemes was partly material, but equally as much psychological. The object was to put the workers and those engaged in the undertaking in a more assured position materially, and to endeavour to secure a better attitude of mind, a less competitive attitude in the minds of the workers.

He thought they must be careful about schemes of profit sharing and co-partnership and should not expect too much from them. They must not look upon such schemes as the universal panacea applicable to all businesses and capable of curing all industrial evils. There were many businesses for which he believed a system of profit sharing and co-partnership was not applicable.

It was no use giving a bonus unless it was sufficient to be a real incentive, and in some businesses it was difficult to give a bonus because the amount the company would have to pay was so large that it would make all the difference between a small profit and a considerable loss.

No bonus or profit sharing scheme should be taken as a substitute for proper wages, or an excuse for not paying sufficient wages.

The object of giving an interest in the undertaking was to make those receiving the bonus take an interest in the undertaking, and look upon the undertaking to some extent as their property, their own, something they would stay by all their lives; the object of the scheme was to induce the employees not to leave the business but to stay together in terms of industrial friendship.

More than eighty persons attended the Conference, which was a considerable success.

The British Gas Industry Through an American's Eyes

THE author, after visiting many gas undertakings of all types throughout Great Britain, gives his impressions of how the Gas Industry stands. Some of his views may be unpalatable, but this outspoken article is certainly stimulating.

By STANLEY JENKS,

Manager Residential and Rural Sales Department of the Northern Indiana Public Service Company ; Indiana Service Corporation ; Gary Heat, Light, and Water Company.

Past National Chairman of the Water Heating Committee, and Past-President of the Mid-West Regional Sales Council of the American Gas Association.

The British Gas Industry has a traditional background of accomplishment, stability, and earning ability. Realizing the presumptuousness of any other course, I would please have it understood that what follows are simply and solely the *impressions* of an American gas man as I have gathered them during a rather extensive trip through England and Scotland this autumn visiting many gas undertakings, large, small, and medium, municipally and privately owned. Any comments I make to supplement these impressions are, of course, just my own point of view, and those of a visitor seeing things differently from what he is accustomed to at home. Such comments are the kind that I would ask of a British visitor to our Company, and they are offered for what they are worth.

There are many approaches to a business so full of ramifications as ours. Production? Distribution? Engineering? Accounting? Sales Promotion? A missionary sees a South Seas islander through totally different eyes than does the trader. At home in Indiana, I am concerned primarily with sales—load-building and gas appliance merchandizing. It is logical, therefore, that, while interested in all phases of the British Gas Industry, I looked hardest and longest at the sales end of it, and my deepest impressions have been culled from that end of it. In any business, the sales promotion manager who knows his stuff will tell you that the key to successful sales promotion is the application of new ideas to old fundamentals. My purpose in Great Britain, primarily, was searching for new ideas, new persuasive factors to help us at home to sell more and more gas to more and more people. Now, as I sit here and sum up my trip prior to sailing for home, I can frankly state that I feel I have been well repaid for my time and effort. I have found some good new ideas. Some current practices here confirm our own soundness in following similar practices in America. Even as a " Pass " from your partner conveys valuable information at contract bridge, I have learned much from the " Passes " I have encountered.

Chaos in British Sales Plans.

While realizing that our Industry's fundamentals on both sides of the Atlantic are identical, I am well aware that every public utility's operating and sales problems are local and call for local treatment. The balance-sheet is the only final answer in deciding whether this or that is right or wrong. Even in my own group of companies, where, comparatively speaking, we are serving a compact number of communities, we find it advantageous to modify our operating and sales plans for local conditions, despite the fact that we have standard policies throughout the group. No, Sir! Sauce for the goose is not necessarily sauce for the gander in this intricate business of serving the public, and, accordingly, I was not particularly perturbed because of an almost chaotic lack of uniformity in British gas sales plans. What did amaze me, though, was the total lack of any sales plans at all in so many of the undertakings that I visited.

It soon became apparent to me—and this is one of the outstanding impressions that remains with me—sales were suffering through engineering domination. Please get me right. Don't put me down as just another salesman throwing his weight around. The engineer is entitled to a major position in this Industry, but primarily as an engineer and not as a sales executive, unless he is just as well qualified and experienced in the technique of salesmanship as he is in the technique of engineering. The mental processes of an engineer and a salesman are so different that it is very rarely that one meets both in one and the same man. I guess I could count on my fingers the number of men I have met in the gas business who were adequately qualified to generate and distribute the gas and then go out and sell it. Creating new markets for the sale of gas and developing further uses for it in present markets is a highly technical job. I friendlily comment that the British Gas Industry, generally speaking, has failed so far to appreciate this fact. Increasing competition for the fuel market, I predict, will speed the discovery.

A Lop-Sided View.

In one of your leading research and testing laboratories, I heard the merits of a British gas cooker extolled to the skies. It had about as much " sex appeal " as an iceberg. Standing alongside it was an American gas range, not so sturdily built admittedly, but in attractive coloured porcelain enamel, not a bolt or nut showing, and designed to appeal to the inherent artistry of a house-proud woman. The one a battleship, the other a graceful yacht, if you please. By a strange coincidence it is the very make and model that I have in my own Indiana home. (I wish it had been a French or Russian gas range to leave me a neutral in this story.) However, the same engineer who was extolling the British gas range was condemning the American to the nethermost corners of a gaseous Hades. Why? Because, according to their *laboratory* tests, the oven of the British gas cooker was 10% more efficient than that of the American. The fact that the American range was far more appealing to the eye, and it was far more convenient to use, and that it was more than holding its own in a country where labour-saving devices are developed to the *n*th degree, cut no ice at all. That almighty additional efficiency was the deciding factor. Let's take a look at the practicability of such an attitude. As I gather it, the average gas cooking bill in this country is about 15s. a quarter or 5s. a month. Assuming that half the total gas used is for the oven—and that is a generous assumption—the more saleable but less efficient cooker would cost threepence per month or less than a penny a week more to operate. A negligible sum and one that would mean nothing to the housewife. As a matter of fact, I brought over with me several photographs and catalogues of American gas ranges, and, without exception, every English housewife to whom I have shown them has said " I wish I had one like that." Both my mother and wife have kept house in America and England and both unhesitatingly declare a preference for the American product. Why? And this is salesmanship and not engineering. They are women with pride in the appearance of their home, of which the kitchen is the workshop. They are practical housekeepers too, with an appreciation for something that makes their job as trouble free as possible. To them as women and gas customers, the design, eye-appeal, and convenience of the one far transcends the thermal efficiency of the other.

Discussing British gas cookers with one of your leading sales executives, he, while conceding the lack of " sex appeal," advanced the idea that British gas cookers had to be as they are because kitchen space is so limited in British homes. This may fit the present situation, but surely it is not one with which the British Gas Industry is going to be satisfied. As with us, your cooking load is the " Bread and butter " of your business, and I believe you are not going to pass up anything toward protecting and developing this cooking load. Everywhere I have been I have been amazed at the number of new homes under construction, mostly being put up by speculative builders, whose degree of success is measured by their success in anticipating the public's wants. If the British Gas Industry could *sell* British housekeepers the desirability of having better (women's viewpoint please) cookers, it is dollars to doughnuts that Mr. Competitive Builder would soon be

giving them the necessary floor space. As it is, the best looking and most convenient range I have seen in England was electric.

" Efficiency " Fanatics.

I found the same striving for efficiency *at all cost* in water heaters, too. As a result, I have to conclude that the British gas salesman is succeeding despite the efficiency fanatics who are shackling his efforts. The engineer, as an engineer, is covering far too much territory, I feel, in the British Gas Industry. In other words, in too many instances as I saw them, the sales end of the business is subservient to and dominated by the operating end. The technical superiority over here is self-evident. In the art of production, distribution, and application, you are miles ahead of us. In this you are well in line with traditional British excellence of production.

Unfortunately it seems to me, the British tradition of " Excellence sells itself " is being perpetuated by too many British gas undertakings. It was Rousseau, I believe, who advanced the theory that if a man should build the best mousetrap in the world and retire with it to the middle of a deep forest, the world, nevertheless, would wear a path to his door. That may have been a sound theory in Rousseau's day, but in our highly industrialized world, it's a different story. Instead of the customer wearing a path to our door, we, to get our share of the customer's shilling, must be prepared to wear a path to his door, and many pairs of shoes in the process. Progress is a degree of dissatisfaction, and dissatisfaction is induced by a created obsolescence. Modern salesmanship is the technique of making this or that obsolete to create a market for one's own product. It is a curious fact that most people rarely become dissatisfied with anything until somebody makes them so. That is why modern business, to survive, must have highly trained and well-directed sales organizations. The managements must be sympathetic to and cognizant of the difficulties facing the sales department, and energetic enough to lend its executive support past the horizon of present sales, if the undertaking wishes to progress. In the gas business, sticking an advertisement in the local newspaper and perfunctorily and haphazardly displaying a few models in a dimly-lit store window and adopting the attitude " here it is if you want it " will not sell speciality appliances like cookers, water heaters, or gas fires. Perhaps my greatest disappointment in Great Britain was the lack of real " go-get-it " sales spirit, particularly in the municipally owned undertakings. We have the same sales apathy in our government owned utilities at home. Everybody's business is nobody's business.

Most of my investigations were carried out as an unostentatious would-be purchaser of this or that. I was not nearly so interested in what a manager said his undertaking did as what the man on the firing line was actually doing. This is the true measure of management. I had some interesting and amusing experiences, which, I hope, I am able to take in their proper perspective.

Amusing (?) Experiences.

" What are you doing to offset electric cooking competition?" I asked one sales assistant in a municipally owned gas showroom up north.

" Oh! that's all right," he answered. " The town owns the electricity too, and it all comes our way." The town will also soon be owning a pile of junk which was once a gas plant if that is the way it is pushing its gas business.

In a privately owned gas company, not a hundred miles from London, I was told to buy a certain type of water heater. On asking why, I was blithely told " Because it's the only kind we sell." Further questioning revealed that this alleged salesman knew nothing about the average hot water expectancy in the average home, the rate per gallon, or the cost per therm, and as for my potentially increased gas bill I was informed brusquely that it all depended on me. Fat lot of selling technique, and typical of the spirit of " Here-it-is. Take-it-if-you-want-it." On the other hand, this salesman (*sic*) could tell me all about the construction of the heater, how it worked, &c. He had, however, no conception of the first fundamental of salesmanship, which is talking in the customer's language. I talked to his boss later, and found, as I'd suspected, that the latter was in the dual capacity of operating and sales manager. His entire background was operating, and from his remarks I gathered that about 90% of his time on the job was spent in keeping up the holder, and very little of it to developing further markets for the use of the gas.

I could list similar experiences by the score. The richest one of all happened, also, in a northern gas company where they refused to let me have a copy of their rates because I, self-admittedly, was not a potential customer. Maybe, they had me under suspicion as a " grid " spy. Probably the most amusing thing of all came to me second-hand. Also in the north. A manufacturer, despairing of getting any aggressive sales effort on his product out of a municipal undertaking, sent in a crew of salesmen to canvass the town and see if some business could be stirred up. The next day the local paper carried a three-quarter column letter from an indignant citizen, the gist of the letter being that it had come to something when the corporation had so far forgot its dignity in hiring *hawkers* (*sic*) in connection with its gas undertaking. Wotta life! Wotta life!

On the other hand, I saw some remarkably fine jobs of sales promotion being done. I had intended to use no names at all in this review of my impressions, but I cannot resist crediting the Croydon Gas Company for giving me one of the most enjoyable, interesting, and instructive days I have spent in the many years I have been in the gas business. Under the leadership of General Manager W. J. Sandeman, you'll find as alert and as aggressive sales activity as you could hope to find in a month of Sundays. The Croydon Gas Company has showrooms, a delight to see, skilfully and artistically arranged to catch the feminine eye. Frankly, I was amazed at the thoroughness of its sales programme, even to the finishing and refinishing of new and used appliances to match any colour or fit any decorative scheme, right there on the Company's premises and in its own shops. The volume of appliances sold is surely closely tied in with the continued increases in revenue the Company reports.

The Lighting Load.

A thing that astounds me, perhaps more than any other among the many things I have seen during the last two months, is the persistency with which the British Gas Industry hangs on to and develops the lighting load. With us, the gas lighting load has almost completely disappeared. I can think of very few gas street lighting systems in the United States. A few of Chicago's suburbs are still lighted with gas. But, whereas gas lighting is a lost art with us, and rarely encountered except in non-electric territory or as stand-by equipment in large stores and theatres, you have it as a very practical and important phase of your business. I even noticed that the lamps at the gateway entrances to Windsor Castle and all exterior lighting there are gas, despite the availability of electricity. The home of one of my hosts in the north was gas lighted, and again electricity was available. Everywhere I went, gas street lighting was the rule rather than the exception. And very good, dependable lighting, too.

I was particularly interested in the remarkable strides made in gas floodlighting. I sat spellbound while Mr. Dodimead, of the British Commercial Gas Association, told me of what had been and was being done. Photographs galore. We have nothing like it in the States, though this year one manufacturer has introduced a 3,000 C.P. high-pressure lighting unit which is being favourably received, I am told, by some gas companies, anxious to take the battle right to the doorstep of the electric boys. Many British gas men laughed when I told them that the biggest immediate field for such a unit with us was for the floodlighting of petrol stations to attract business and to afford protection against hold-ups. You are fortunate in having so many manufacturers with such a splendid variety of gas-floodlighting equipment available. My only doubt is the direct value of the floodlighting load, seeing that most of it is very temporary, and generally used to mark some special civic celebration or anniversary. Its real value, I suppose, is indirect in establishing gas service as an efficient, more economical, and more dependable light source. I am going back home with some definite ideas on this subject. and it won't be my fault if some of our electric competitors don't receive the shock of their lives one of these dark nights.

A Bit Casual.

I was interested in your water heating load developments, because, at home, we figure it as our first incremental load after the base cooking load, and therefore one of the utmost importance. You seem to take it more casually here. Or is it that your problem is so much more difficult than ours, with far less reward for your efforts? Our central heating and the necessity for an independent hot water heating system to take care of the summer months make our task of selling some kind of gas water heating equipment comparatively easy. The base of all gas sales problems is the climate, and the climate in the British Isles, I would say, makes it tough for the water heater sales boys. Professor Boswell, speaking recently before the British Association in Aberdeen, said that in America the individual uses 100 gallons of water per day, whereas in England the figure is 35 to 40 gallons. This doesn't mean that we are any cleaner, nor does it imply, because of prohibition, that we have acquired an abnormal taste for drinking water. It does mean that our climate makes us need more water. We estimate in Northern Indiana that the average

individual hot water (140° F.) requirement daily is about 15 gallons. It also shows that your potential load from water heating is much less than ours, and therefore, in like degree, less interesting.

However, the fact that there is not a gas undertaking in this country with anything like a full capacity load on its mains emphasizes the importance of the water heating load, and the fact that every gas undertaking I visited was displaying water heaters of some kind or another indicates that there is a realization of the desirability of this load. But, again, when it came to planning on acquiring the load, I found a deplorable lack of factual thinking on the subject. In some places I found water heaters being recommended that didn't have the chance of a wax cat in hell of operating successfully due to water conditions. Executive indifference? There are some mighty good water heaters available in Great Britain, and they deserve a better fate than their present lot. "Nuff sed."

Dealer Support.

In the United States, facing the most intense competition in our history, we have felt it good business to enlist the support of every dealer who could possibly be interested in the sale of good gas appliances as a part of his regular business. Hardware, furniture, and appliance dealers were lined up particularly in the gas range field. Plumbers and heating contractors were encouraged to sell water heaters, partial and central heating equipment. We felt that the more people who were profitably occupied selling gas equipment, the stronger our sales effort would be, that more gas appliances would be sold, and we, primarily interested in the more extensive use of gas, would be the big gainer. It should be admitted that we had apparently a more fertile field to cultivate. Our dealers are a different proposition entirely from yours. And that probably explains why I saw nothing of such dealer co-operation in the sale of appliances in this country. It is a subject on which I would not care to comment without being in full possession of the economics. For there would have to be some sacrifices in merchandizing volume and some compromises and adjustments in merchandizing methods before the dealer could be induced to go into the appliance business alongside you at a profit. One undertaking bragged to me that it had a "sole agency" contract with some distributor, entitling it to a longer discount, and enabling it to whip all potential competition (and it didn't mean electric, coal, or oil, either). Another admitted that it sold at retail with a mark-up over invoice cost of 10%, which anybody knows is not enough to pay its direct sales expense. No dealers, of course, can survive such competition.

What of the dealers themselves? Well! I talked to several of them, men displaying electric, coal, and oil ranges on their floors and in their windows. A few said they weren't interested in selling gas ranges, which is reprehensible in itself. The great majority of them were bitterly hostile to the gas undertaking, because of its appliance sales policies. Certainly. Of course they were interested in selling anything on which they had a chance of making a profit, and they'd handle gas cookers, too, but for the blanketty-blank, &c., &c. (meaning the gas company). Some of them took a venomous delight, so they said, in selling oil and coal cookers. None of them was friendly.

The British Gas Industry is apparently prosperous and getting along nicely, thank you; and that should be enough for any man, especially a fellow like myself from a country where, during the last few years, things could have been worse—but not much worse.

My impressions, as outlined above, have been briefly but honestly given. Whether they strike you as naive, presumptuous, or asinine, please give me credit for their sincerity. As for my comments, they are just my own point of view, and those of a man who has spent the best years of his life in the sales end of the gas business; a man who is proud to be in a business with the promise of a greater future than its past; and a man who from the bottom of his heart wishes his British colleagues complete success in securing for their business the development it so richly deserves.

The Solid Products of the Carbonization of Coal

Published by the South Metropolitan Gas Company Chemical Department

Reviewed by L. H. Sensicle, B.Sc., F.I.C., M.Inst.Gas E.

The South Metropolitan Gas Company have for many years been among the leading advocates of the policy of improving the quality of gas coke and popularizing its use for domestic purposes. The importance of producing a coke capable of commanding a fair price on its merits is pointedly emphasized by the author's reference to the fact that for their Company a fall in the price of coke of 1s. per ton represents a loss in revenue of about £25,000 per annum. Their intensive attack on the problem dates from the period of the heavy slump in the price of coke during the years 1920 to 1925 and the results of about ten years' work in the Chemical Department of the Company are included in the volume under review. The burning of coke in the open domestic grate has been studied with considerable thoroughness; the authors have regarded the property of "ignitability" as of outstanding importance, and their logical approach to an understanding of the principles governing the rate of "pick-up" of a coke fire makes interesting reading.

As was inevitable, and is indeed admitted, much work was done which merely served to confirm results already published by other investigators. There is also evidence that simultaneous duplication of work being carried out elsewhere has also occurred. At all events there are presented sufficient data to enable certain conclusions to be reached as regards the potentialities of the products from the particular types of coal and carbonizing plant used by the Company. The extent to which these conclusions can be broadened to be of value to those using different types of coal and carbonizing plant, for example coke oven managers, will always be a matter for discriminative judgment based on the personal experience of the individual reader.

Ignition temperature was measured in an apparatus similar to that employed by the Northern Coke Research Committee in which preheated air passes through a shallow bed of graded powdered fuel (20-30 I.M.M. sieve) in a silica tube. The authors confirmed the existence of a relationship between the temperature to which a coke has been carbonized and its ignition temperature on combustion, and also established a connection between this characteristic and the relative completeness of expulsion of volatile matter (mostly residual hydrogen) from the coke. They also measured the combustibility of a bed of 10-20 I.M.M. mesh coke by recording the rate of advance of the expanding arc of "fire zone" when the coke was ignited at a single point near the wall of the 5 in. diameter cylinder in which it was confined. This test was found to be a definitely discriminative laboratory method of comparing the combustibility of cokes and was capable of forecasting their behaviour in the open well grate.

A laboratory-constructed open grate, used without chimney to eliminate the effects of variable draught, was found, as was expected, to be even more effective in comparing ignitability, which was measured by recording the rate of increase in the radiation received at a certain distance from the fire after it was kindled. The method would be of value in appraising low-temperature carbonization products prepared with an eye to ease of ignition, but is unnecessarily unfair to high-temperature coke. This was recognized by the authors who employed for the latter a standardized form of lighting test in which their own "Metro" grate, specially designed for high-temperature coke, was used. A point which does not seem to be sufficiently stressed, however, is that by virtue of employing the gas lighting burner for a sufficiently long period, the rate of "pick-up," as measured by the rate of increase of radiation received, could be made the same for all the high-temperature cokes tested. Thus combustibility was only of importance in so far as it affected, to the extent of 5 or 10 minutes the total period during which gas was needed for kindling, and also perhaps as regards the ability of cokes to burn low and recover after replenishment of the

fire. The "Metro" grate is in a sense a reversion to the old-fashioned barred grate which is more satisfactory for coke burning than the well type. It also embodies substantial firebrick-work at the back and sides which acts in a regenerative manner and assists in keeping the body of the coke above ignition temperature. The fuel bed is deep, and this in itself helps to provide the intenser draught conditions required to sweep away the film of carbon dioxide which forms on the surface of unreactive cokes.

An interesting feature of the grate described is the sloping firebars which induce a rolling motion of the coke from front to back as the pieces shrink and so assisting in loosening the adhering ash. On the question of ash the authors make some interesting comments. They claim that volume is of more consequence than weight, and that fine crushing of coal before carbonization is undesirable from this point of view since pieces of shale become finely disseminated in the crushed condition and enhance the volume of resultant ash. Elimination of shale from the coal before crushing is the obvious remedy which coke oven managers have applied for many years past, and it would be difficult to convince them that crushing below ⅜ in. before carbonization is not a *sine qua non*. On the other hand it is an interesting reflection that in other branches of the carbonizing industry there is more than one good reason, such as the ability to get a heavier charge into a horizontal retort, why crushing coal below 2 in. is considered, not only unnecessary, but undesirable.

The authors establish the importance of ash volume as a factor in reducing the total radiation from a coke fire, and have attempted to lay the blame for this high ash volume on that ash derived from the inherent ash of the coal rather than from shale. This is only a partial truth. Their selection of 1·5 as a border specific gravity is sufficiently high to include some "middlings" of high ash content in the coal "floated" fraction. A specific gravity limit of 1·4 would be a surer means of separating true coal and arriving at the "inherent" ash. In the present writer's experience, however, ash volume varies largely according to the seam from which the coal is derived. Though crushed below 50 I.M.M. for the purpose of analysis some coals give quite a compact ash in the silica dish while others give a bulky one. This is partly a question of chemical constitution. One of the best Welsh house coals is regarded as such not only because its ash content is low by weight, but because it is also compact. The ash is of a dark brown inconspicuous colour and clinging nature which reduces its tendency to fly about the room. The virtues of such a coal are obvious. The authors do not appear to regard with sufficient disfavour the presence of "bats" in coke derived from pieces of shale in the coal, beyond calling attention to the tendency of such fragments to explode on the fire. Gas engineers would be much more ready to insist on the exclusion of shale from coal by cleaning at the pithead were it not for the insidious fact, demonstrated by Plevin before the Auxiliary Section of the North of England Gas Managers' Association ("JOURNAL" for Dec. 4, 1929, p. 653), that shale contributes appreciably to the gas yield, and that, therefore, its exclusion from the coal does not result in so great an improvement in gas yield as would be popularly supposed to result.

The book describes work on many phases of coke research, and ingenuity is shown, as for example in the method of determining the effect of graphitic carbon content on ignition temperature, and in the method for determining the reactivity to steam which was adopted in preference to the more usual determination with carbon dioxide. The authors regard 700° C. as a critical temperature in the carbonization process, and an indication of the avenues of approach they have followed in the study of the subject is afforded by the following quotation: "Reviewing the results which were obtained by examining the solid residues of carbonization in the several ways described, there remains no room for doubt that there is a temperature in the neighbourhood of 700° C. at which a profound alteration in the properties of these residues occurs. The contraction in volume, the large increase in electrical conductivity, the decrease in reactivity to sulphuric acid, the loss of ability to be dispersed in sulphuric acid, the attainment of and fall from maximum adsorptive power, the rise in ignition temperature and fall in combustibility, all point in this direction. . . . It follows that . . . a smokeless, solid fuel, readily ignitable and freely burning in the ordinary domestic grate can be obtained by the carbonization of coal at temperatures below 700° C."

In a preface signed "E. V. E." it is claimed that the general trend of evidence from the several branches of work described "points so conclusively in one direction that in that direction the truth may be assumed to lie." It is not clear whether it is the above-mentioned conclusion that is referred to. The advocacy of carbonization below 700° C. is tantamount to recommending universal low-temperature carbonization. It appears more probable that the general impression derived from the book will be that the authors have not made up their own minds as to whether the evolution of grates such as their own "Metro" design does not finally dispose of the need for carbonizing at temperatures below 700° C. to produce domestic smokeless fuel. Incidentally, it is noteworthy that 700° C. marks a further increase in the proposed upper limit of temperature for "low" temperature carbonization. In the case of true "high" temperature coke to be used in the "Metro" grate, the authors advocate leaving 2½ therms of gas in the coke. In this matter they are approaching the policy followed a number of years ago by American users of narrow coke ovens for domestic coke manufactures—namely, to push the coke with a "mourning band" down the middle of the charge, *i.e.*, before the middle was fully carbonized and had probably not exceeded 700° C. The reviewer would like to presume to congratulate the South Metropolitan Gas Company on their publication and the very considerable contribution they have made to the solution of an important problem.

The Law Relating to Smoke and Noxious Fumes.

A book of value to all who are concerned with the legal aspect of atmospheric pollution, either as potential offenders or as those who have to administer the law, has just been issued by the National Smoke Abatement Society. This treatise on the law relating to smoke and noxious fumes marked the conclusion of much valuable work on behalf of the Society by the late Mr. Randolf A. Glen, who was Recorder of Penzance and Standing Counsel to the Society.

In a foreword to the volume, Sir Lawrence Chubb, the Honorary Advisory Secretary of the Society, reveals that the volume was written in a sick room during Mr. Glen's last illness.

The author's great knowledge of Local Government law has been extensively drawn upon in the book, which, as Sir Lawrence Chubb writes, "will prove an invaluable guide to those whose duty it is to protect public health from unnecessary and avoidable dangers."

In this little book the whole of the domestic and industrial field is covered. The operation of the law is clearly defined in relation to smoke emitted from dwellings, business premises, railways, steamships, and road vehicles. In the latter case, exhaust from internal combustion engines is dealt with as well as smoke from steam wagons. A chapter has also been devoted to the special position of London with regard to legislation dealing with the emission of smoke, which it should be remembered is used as a general term, but includes ash, grit, and gritty particles.

The book is published at the price of 1s. and may be obtained from the headquarters of the Society, No. 36, King Street, Manchester, 2.

Coke Oven Managers' Year Book.

The Coke Oven Managers' Year Book, 1934, published by Benn Bros., Ltd., for private circulation only, is now firmly established as a record of practical work and information, valuable to all who are in any way interested in coking practice.

In this, as in previous issues, the usefulness of the book is preserved by the inclusion of only such matter as is considered likely to be of service. Included in the contents is useful information on the rules and membership of the Coke Oven Managers' Association, with lists of officials, past-presidents, and members. Further progress has been made in the compilation of the list of coke oven plants abroad. Several new sources of information have been obtained, and the lists for France, Belgium, Poland, Czecho-Slovakia, Spain, Japan, China, Manchuria, and all parts of the British Empire may be regarded as absolutely correct.

The remainder of the volume is devoted to the transactions of various sections of the Association, full reports, with photographs and diagrams, being given of the various papers read. Altogether this is a very useful book, summarizing in a comprehensive manner another year's activities of our sister industry. Users of the book should find it fully as valuable as its predecessors.

Domestic Coke Appliances in Relation to Coke Sales and Smoke Abatement*

By E. W. L. Nicol, Assoc.Inst.C.E., F.Inst.Fuel, Technical Adviser to the London and Counties Coke Association.

Probably the most valuable work of the London Coke Committee, commenced in 1913, in securing for coke its legitimate place in the domestic fuel market, was the development of the coke-fired domestic boiler. This important work, now being carried on with increased influence and resources by the London and Counties Coke Association, together with improvements in the standard of quality, grading, and service, should have an important bearing upon the price of gas in future years by maintaining for coke a full and permanent share in the 40 million tons domestic fuel market, which is probably the most stabilized of all markets for coke.

Selling coke is not merely the disposal of large tonnages. To be effective, the selling of coke, or for that matter any commodity, must combine the ability to place the fuel in the most suitable and remunerative market, or in creating a new market where none exists.

In this connection, Sir David Milne-Watson, President of the National Gas Council and founder of the London Coke Committee, has repeatedly emphasized the fact that the price of gas depends more than anything else upon the price realized for coke, and that the value of coke per ton of coal carbonized is fundamental to the maintenance of our position and progress.

The Domestic Coke Boiler.

Prior to the formation of the London Coke Committee there was only a relatively small domestic demand for coke; there were no open coke fires, and the only domestic boilers available were of the plain, unattractive type. There was little or no attempt at refinement or finish, and the facilities provided for stoking and cleaning were of the crudest description. Recognizing the great potential of the coke boiler as a means to develop and maintain a new and stable market for coke, the Committee approved a standard specification, drafted by the author, which was circulated among boiler makers calling for tenders for the supply of welded steel and cast-iron boilers of attractive design and finish, and providing for continuous working and internal and external cleaning. As a matter of interest, bearing upon the development of the modern coke boiler, a copy of this specification was published in the author's book on "Coke and Its Uses."

The outbreak of War in 1914, and the subsequent high cost of materials, combined to prevent the manufacture and introduction of the modern coke boiler until the year 1921, when the first "Sentry" boiler produced was tested and approved by the Committee. This boiler, which with others was included in the Committee's advertising campaign to popularize coke as a domestic fuel, was followed by the "Glow Worm" and "Ideal"—trade names which have since become "household" words.

Following substantial reductions in cost, increasing numbers of makers have entered the market, producing coke boilers at surprisingly low prices, most of which have achieved remarkable success. In spite of the notable development and growing popularity of the coke boiler, during the past 13 years, there has been practically no departure from the original annular type or the conventional "horse-shoe" type, with fixed grate and the usual mica-panel open-fire feature, which, in the modern kitchenette, measuring about 8 ft. by 12 ft., is of questionable utility.

Probably the most remarkable development in boilers of the latter type has been the addition of cooking facilities, in the form of ovens and hot closets. This addition may be useful, and there is no reason to doubt its utility in districts where gas is not available for cooking; but for town use it must be regarded as a retrograde step, re-introducing all the disadvantages of the dual-purpose kitchen range. Everyone knows that cooking operations and the demand for hot water for baths, &c., seldom synchronize; the water becomes over-heated and pipes furred up; and however useful the combined hot water boiler and cooking range may prove to be, it cannot be regarded as efficient if surplus hot water, generated during cooking operations, has to be run to waste. The present tendency to eliminate the fragile mica panels is a step in the right direction. They are difficult to replace; and, once broken, accurate draught regulation becomes impossible.

Perhaps the most regrettable tendency in coke boiler design is due to the present competition in price cutting. This has led to the production of badly-fitted boilers of such minute dimensions and limited fuel capacities that to associate them with the advantages of "constant and abundant hot water" is to delude the buying public, and can only result in disappointment to the users and damage to the trade.

Inadequate boilers of this category not only entail "forcing" with consequent damage due to overheating, and unnecessarily heavy fuel consumption, as well as almost constant attention, but they also give results which are far less satisfactory than those obtained with a modern boiler of adequate capacity, costing only slightly more to buy, but no more to install. A modern boiler of adequate output and fuel capacity never needs forcing and will give constant service over a period of fifteen to twenty years or more, at the minimum of cost for fuel and attention. Its consumption of fuel during its useful life-time will represent an expenditure amounting to many times its original cost, so that the economies in fuel and maintenance rendered possible may very soon off-set the relatively small difference in price, compared with that of the small and inefficient boiler. The design and production of such boiler is no doubt due to the demand and pressure from the speculative builder, who is naturally inclined to over-rate the importance of low first cost. When the development of a building estate is under consideration, the temptation to save a few shillings, or even pence, on hot water equipment will influence his decision in favour of the cheapest boiler. Such penny-wise cuts may, and often do, prove to be anything but economies in the long run; and it is greatly to the credit of boiler makers and builders of repute that they refuse to be associated with the production of boilers of this description.

Boilers of this small inadequate type are also causing great difficulty to fuel producers, as they tend seriously to discredit the fuel used in them. No effort or expense has been spared to produce and distribute evenly—and suitably—graded gas coke for use in domestic boilers of all normal sizes. In addition to the use of more expensive coal from which the coke is made, gas undertakings who are members of this Association have also expended, within the past three years, a total of £1,500,000 on coke grading plant designed almost solely for the production of coke of improved quality and the various grades required. During the same period they have expended more than £80,000 in advertising domestic coke burning appliances; but, so far, the appliance makers have not generally co-operated by making provision for the best and most efficient use of coke as fuel.

The continued success of a domestic coke boiler installation depends mainly upon an adequate supply of smokeless fuel correctly graded for continuous working with a minimum of attention. Produced in every city and town, gas coke is by far the most widely distributed smokeless fuel in this country, in addition to being the cheapest, on a price and calorific value basis. Compared with relatively expensive Welsh anthracite, the alternative smokeless fuel, the total yearly output of which is only about 6 million tons (of which output more than 4 million tons are exported) the yearly output of gas coke is approximately 8 million tons. From these figures, and the fact that London and the South are by far the most important markets for coke boilers, the importance of co-operation and collaboration between the boiler makers and the principal fuel producers, in their respective interests, will be apparent. Personal contact with many boiler makers tends to prove that on their part there is no lack of interest. Suggestions made with a view to improve the facilities provided for using coke as fuel have readily been adopted. These improvements include correctly spaced firebars, gas-ignition, shaking grates, adequate fuel capacity, and graduated dampers, and also the issue of working instruction cards giving particulars of the correct grade of coke recommended for use in each size boiler.

The growing "coke mindedness" of the public and appreciation of graded gas coke as a slow-combustion smokeless fuel, since the inauguration of coke propaganda and publicity, may be gauged by the fact that practically the whole output of certain gas undertakings is now sold for domestic hot water and central heating purposes. Similar, but more recent, progress in popularizing coke has been made in the United States of America. Statistics pub-

* From a paper before the Coke Salesmen's Circle, London, Oct. 24, 1934.

lished by the Bureau of Mines, Washington, show that whereas the coke sold for domestic use in 1924 was only 2,952,000 tons, the quantity sold for the same purpose in 1933 was 10,491,000 tons, an increase in 10 years almost equal to the total British yearly output of gas coke.

From information supplied by the Building Industries National Council, 330,000 boilers, in addition to 1,700,000 grates and ranges, will be required for the equipment of new dwellings to be erected in 1935, if the present rate of house building in this country is maintained. The average yearly coke consumption of a domestic hot-water boiler is approximately 3 tons, so that if only one-third of the estimated number of boilers required are coke-fired, next year's increment in demand for graded domestic coke may amount to more than 300,000 tons. These facts and figures may indicate a line of policy that should receive, from all concerned, the careful consideration which their importance clearly warrants.

Coke salesmen, who are privileged to make personal contact with a very large number of domestic coke consumers, are well aware of the difficulties that sometimes arise in operating coke boilers, especially those of the smaller capacities. Probably the most common difficulty experienced by users is in maintaining the fire alight over-night with any degree of certainty. Personal investigation of a large number of complaints has shown that the difficulty experienced, although almost always attributed to the coke supplied, is in fact due mainly to the inadequate fuel capacity and air spacing of the boiler firegrates. All that is possible in correctly grading the coke for use in the various sized boilers has been achieved by the associated gas undertakings; and supplementary fuel hoppers designed for use with the smaller boilers have been provided by the Association. Further improvement rests mainly with the boiler makers, if their boilers are to give the satisfaction that users are entitled to expect.

It is proposed to modify existing grates of the fixed pattern, so that they may be used as shaking grates; to provide access for a gas poker; and to graduate sliding chimney dampers in order to facilitate more accurate draught regulation for banking over-night.

These desirable improvements involve no serious alteration to existing patterns, and very little, if any, cost in production; and a number of important boiler makers have already arranged to have the necessary alterations made to existing patterns, in order to give effect to the Association's proposals. In future, only those boilers which comply in this respect with the Association's requirements may be adopted for recommendation.

A feature of the domestic coke boiler that has appealed to the public in the past, and will, no doubt, continue to do so, is the open fire; but in actual practice, the open boiler fire, with coke alone as fuel, cannot be regarded as altogether satisfactory. Surrounded as it is with cold water, this is only to be expected; no smokeless fuel in these circumstances can continue to burn actively and satisfactorily. There follows the temptation to use ordinary household coal, which deposits carbon, scale, and soot on the heating surfaces of the boiler, with results that not only involve frequent flue cleaning, but also seriously and permanently impair the efficiency of the boiler as a water heater. Installed in a small kitchen or modern kitchenette, alongside a gas cooker, the boiler with the open fire feature, whether open or closed, would no doubt render the temperature of the apartment almost unbearable, when both boiler and cooker are in action. It is suggested, therefore, that in order to meet modern requirements, a departure from the conventional " horse-shoe " open-fire design is overdue.

For use in flats and houses where space is limited, the solid-fuel water heater of the future may well be of the annular water-way type, with combined shaking, dumping, and gas ignition grate only. Supported at a convenient height, it should occupy a minimum of floor space. Graded coke, packed in cartons made to fit the boiler, may facilitate stoking and storage, but would be relatively costly.

The Open Coke Fire.

Although introduced at a much later date than the coke boiler, the reception and success of the open domestic coke fire has been no less satisfactory. Unlike the coke boiler load, which is largely continuous and non-seasonal in character, and, therefore, perhaps more important, the use of the open coke fire is almost entirely discontinued during the summer months. The seasonal demand for open fires, occurring as it does at the period of maximum coke output is, however, no less desirable, and promises to become almost equally important, as a market for gas coke; and whereas the coke boiler load is shared with competing fuels, the open coke fire generally is the undivided prerogative of gas coke.

In the light of present knowledge, the first essential feature of a satisfactory coke grate is a maximum of free air space in the bottom grating, with a minimum of $\frac{3}{4}$ in. between the firebars. This simple variation from traditional coal-grate practice, which allowed only $\frac{3}{16}$ in. to $\frac{3}{8}$ in. spaces, eluded generations of inventors and investigators until, a few years ago, Mr. R. O'H. P. Theobalds demonstrated his open coke grate to the London Coke Committee at the Horseferry Road Office of the Gas Light and Coke Company. The development of this grate, now widely known as the " Metro," is due to the South Metropolitan Gas Company, who have expended on it a great deal of time and energy. The Company has also incorporated the gas-ignition burner. The phenomenal success of the " Metro " open coke fire has already led to the evolution and development of a number of similar gas-ignited coke grates, each with its own distinctive feature and selling organization, and all of highly attractive design and finish —a desirable result which should be very gratifying to all concerned in its development.

The growing popularity of open coke fires, in spite of deeply-rooted prejudice and the " coke fumes " bogey, is evidenced by the fact that up to the end of last year more than 69,000 had been installed, including many in hospital wards. The present yearly rate of installation by two London gas companies alone is more than 14,000.

To ensure quick ignition by means of the gas-ignition burner attached to each grate, the question of quenching, screening, and grading of coke for open fires is no less important than that required for coke boilers, although accurate sizing is probably less important. A reasonable increment of smalls is in fact an advantage, as it tends to promote primary ignition of the coke, and re-ignition when the fire is replenished.

Having regard to the national importance of smoke abatement it might with advantage be considered that many of the coal grates, wash boilers, and ranges in existing dwellings could be re-designed beneficially to use coke on the lines indicated. Solid fuel appliances of this description would no doubt appeal to the Ministry of Health and those housing authorities who realize the importance of mitigating the evils which arise from the domestic smoke nuisance.

Discussion.

Mr. H. C. Smith (Tottenham), the Chairman, in opening the discussion, drew attention to Mr. Nicol's remarks regarding the work of the London Coke Committee in 1913 in developing the coke-fired domestic boiler; but he had omitted to say how much of this development was due to Mr. Nicol's own efforts, and he would like to say how much their thanks were due to him for his work in popularizing the coke boiler. He had touched upon one of the snags of the business when he referred to the boilers of very small capacity which some makers were putting on the market. He said that reputable boiler makers would not manufacture these small boilers; but, unfortunately, in order to defend themselves and retain their business they would be compelled to produce these small boilers unless some action was taken to make the public realize that a very small boiler was not a suitable appliance to purchase. Mr. Nicol had also referred to the open coke fire, which, to Mr. Smith's mind, was one of the finest outlets—after the coke boiler—for the sale of coke; and he was only sorry to learn from conversation with representatives of the Gas Industry that there were still a few gas undertakings who were averse to pushing the sale of open coke grates because they thought it would have a detrimental effect upon their sales of gas fires. That was absolutely a wrong view to take. Their Distribution Department could sell gas fires in positions where gas fires were suited; but if they were going to be perfectly honest they could not tell their consumers that a gas fire was the most economical means of continuous heating for a whole day's use. But the open coke grate was; and he hoped it would not be very long before all gas undertakings came to the same conclusion—namely, that the coke grate and the gas fire could go hand in hand.

Mr. Nicol had also referred to the coke fire introduced by Mr. Theobalds, continued Mr. Smith. But he had not mentioned Prof. Boys' work in making coke burn with a very small draught. He had shown that they only needed a firebrick and no ironwork. Unfortunately, however, such fires were rather too large for the domestic consumer, while there was also some difficulty in getting rid of the ash. It was, nevertheless, the proper way to burn coke. He did not know whether those present had ever inspected a coke fire burning alongside a low-temperature fuel fire; if not, they should take the earliest opportunity of doing so. For they would thus appreciate that low-temperature fuel was not a serious competitor to coke. If they wanted a selling point for coke they had only to compare the two fires. The coke fire was clean and bright; but the low-temperature fuel fire, while giving off a good heat, was of a dirty appearance with ash adhering to the surface of the fuel. This last point was rather important, and they should realize that the fires had these differences. A coke fire in a properly designed grate was much more attractive than a fire using low-temperature fuel, and he did not think they had any need to be seriously afraid of competition from this fuel. They as coke salesmen had got to have the right fuel to sell, and it was up to those on the Technical Committee of the Association

to try to assist the members to produce the right fuel, and this co-operation was going to lead in the next few years to a probably embarrassing increase in the demand for coke.

Specification for Boilers.

Mr. W. L. BOON (Manager of the Association) emphasized the folly of regarding the open coke fire as a competitor to the gas fire. The suggestion that open coke fires were detrimental to the sales of gas fires, was disproved by a recent analysis covering the installation of 69,000 coke grates which showed that of that total number installed, 84% represented entirely new business, and only 16% could be traced directly and indirectly to displacing gas. If, however, they regarded this 16% as lost business, it must be appreciated that the gas load produced in the 84% more than covered the loss. But even of the 16% as many as 12% were doubtful; so that only 4% were actually definite displacements.

Mr. FREETH (Winchester) said that his Undertaking adopted the practice of showing a coke boiler at work in their showrooms and inviting all the builders in the district to come and inspect it. They had expressed themselves very pleased with this arrangement and had promised to confer with his Company when considering domestic boilers for their new houses.

Mr. LAWS (Tottenham), referring to the new design of grate brought out by the Association to replace existing grates, said that since there were so many boilers already fitted in houses, it followed that it would be many years before these new types could be installed. He also referred to the difficulty of the grates having no aperture for the insertion of the gas poker. However, he liked the scolloped edge of the grate and also the increased air space. He had found that the hopper which had been developed by the Association to enable small boilers to be kept in for longer periods frequently had to be machined, as the flange did not fit and allowed a certain amount of air intake.

Mr. BROWNING (Tottenham) also advocated the elimination of the mica front in coke boilers. He had found, however, no difficulty in regard to their replacement. Mr. Nicol had stated that gas coke was a most flexible fuel, and if it was desired to maintain a fire continually for hot water, coke was definitely advocated as being more economical than anthracite. If coke was to be packed in cartons, as had been suggested, the cost would go up probably to a prohibitive price.

No Difficulty in Maintaining Fire.

Mr. PYE (Barnet) said that they made coke at Barnet from ¾ths of an inch downwards, and they had no difficulty whatever in maintaining a fire alight for twelve hours without attention in the boilers used on his district. When they could not recommend beans they recommended a mixture—which satisfactorily overcame the trouble of night burning. They must not forget that a large number of small boilers were already installed and would remain installed for a long time to come. These did present difficulty and expedients were necessary to make them serviceable. His Company supplied front plates for fitting to coke boilers so that gas pokers could be used.

Mr. KERRIDGE (Croydon) said that however desirable it was to design larger boilers, they must face the fact that as the ability to grade coke increased so complaints decreased.

Mr. ASHLEY (Gas Light and Coke Company) remarked that they were faced with having to deal with thousands of boilers which would last for years, and which were inadequate in size for the work they were supposed to do. It was with difficulty that these small units were kept going, and it reflected a great deal of credit on the supply companies who were providing coke and service to give satisfaction to users, whereas the fault lay with the appliance and was not a matter which the fuel supplier could cure.

Mr. LAWS inquired who was going to provide the plate in the front of boilers for insertion of the poker, mentioned by a previous speaker. His Company tried to deal with apparatus as they found them, and generally discovered that 99% of trouble was due to bad fitting of boilers. The sealing of the flues was most important, and he suggested that it was good policy to get in touch with the builders with a view to persuading them to fit boilers properly and, if possible, enable them (the gas company) to inspect the finished installation. It was the small details which were important.

Mr. SMITH remarked that the cleanest coke and the dryest coke was usually prepared by screening out the large coke and then cutting it to the size required; and the smaller size to which the large is cut increases the proportion of breeze and the cost of cutting. Still it could be done if all boilers were going to be small ones, though it would put up the cost of preparing the coke for the domestic market enormously.

Continued Production of Small Boilers.

Mr. BOON observed that they had decided that their greatest bugbear was the small boiler. They had to contend with the small boilers which were already out on the market, and that difficulty could to some extent be overcome; but it did not excuse the great fault which permitted their continued production. That was the evil. They were not protecting the public; for these small boilers were definitely not satisfactory. The fact that they could be made to do by resorting to expedients was not getting over the difficulty. The householder could not be expected to understand the exact operation of his boiler; very few could spare the time to study the fine adjustments necessary to keep the small boiler in operation. It was necessary, he added, to provide a boiler which the ordinary householder could operate and get satisfaction from, not one which required an expert to keep it going.

Mr. MINNION (Gas Light and Coke Company) also stated that he could show people how to keep their boiler fires in all night—with absolute certainty that they would not succeed in doing it when left to their own devices. He agreed that the only cure was to provide boilers of adequate capacity.

Mr. ALMOND (Watford and St. Albans) remarked that his undertaking decided recently to make a big push of open coke grates, and in the course of the next few weeks they would be endeavouring to popularize the open coke fire as far as possible. They were placing the grates out on hire purchase, by which means they hoped to bring valuable coke business to the Company. In addition, they were writing to every surveyor and builder and all concerned with the construction of property in their district to see if they could get coke grates installed. This followed the lead taken at Leeds, where, according to Mr. Boon's recent report, open coke fires were being installed in houses on a Municipal Estate. He inquired if anyone had adopted a standard charge for fixing these grates and whether others fixed them themselves or relied on the builder.

Mr. SMITH remarked that his Company went a step further and supplied coke grates in the houses of their slot consumers, obtaining their payment by giving the consumer 1 c.ft. less gas for each 1d. until the fire was paid for. This included the cost of the fire and also the estimate of the fixing.

Mr. DONALDSON (Tunbridge Wells) said that his Company also tried to contract for coke supplies; but sometimes consumers burnt coal during the period—which they could not prevent.

Insufficient Storage.

Mr. COLLIER (Lea Bridge) observed that his Company recommended one grade of coke for the boiler and another for the open grate, which brought them up against the difficulty of storage. The modern small house did not allow of sufficient storage space, and people did not want two different grades of coke.

Mr. PIPER (Barnet) remarked that when consumers realized the advantages to be obtained by the use of the two grades they would make provision for additional storage.

Mr. BROWNING said that the majority of builders in his area put in a gas point by the boiler so that a gas poker could be used for lighting, a convenience which was appreciated by the householder.

Mr. LAWS said that in the north of the country people could usually provide one, two, three or more tons storage space; but in the south there was often no storage at all. Any influence which the Coke Association could bring to bear in the direction of urging authorities to insist upon more adequate fuel storage space in houses would be very valuable.

Various other points were brought up by further speakers in the course of the discussion, among them the question of maintaining coke grates during the period of hire purchase agreements, which would put up an undertaking's maintenance costs, while Mr. UNDERWOOD (Braintree) urged that manufacturers' attention be drawn to the matter of providing a suitable connection for the gas supply to the igniting burner. It was also urged that undertakings should fix the coke grates themselves, while Mr. BOON suggested that the maker was the proper person to fix it, as he would then be responsible for its subsequent satisfactory working. Emphasis was also laid on the fact that builders should be persuaded to run the gas supply to the grates under or behind the tiles of the fireplace so as not to disfigure the latter with ugly piping. Another member said that with the use of the coke hopper a coke boiler had run for 25 hours without attention.

The Author's Reply.

Mr. NICOL, replying to various points raised in the course of the discussion, said that Prof. Boys was one of the pioneers of the open coke fire. He had pointed out that a better fire was obtained if no metal contacted with the burning fuel. A difficulty, however, was getting rid of the ash which accumulated in the hearth. Prof. Boys' open coke fires were shown by the Gas Light and Coke Company throughout the whole period of the Exhibition at Wembley, and were very much admired. Mention had been made of the cross rib on the grate preventing access of the gas poker to the fire. This rib was there to prevent the collapse of the grate in the event of fracture in two places. After a boiler had been in use some time the mica screens became a nuisance, and it was advantageous to replace them with sheet metal. He agreed that Welsh coal and anthracite could be burnt at a very slow rate—so slowly, indeed, that they produced no hot water at all. Coke could be burnt at the rate of 0·8 lb. per hour or less and would go on producing hot water. But, in any case, his reference had been to smokeless fuel, and Welsh coal was not a true smokeless fuel.

The Association had made provision for the exchange of grates on small boilers. Another matter of importance was the distortion of the doors of coke boilers, as this would upset the draught. As regards the storage trouble, certain modern coke boilers were specially designed to burn the same grade of coke as the open fire, thus dispensing with the necessity for separate accommodation. In conclusion, he agreed that the gas burner connections to coke fires were capable of very considerable improvement.

On the proposition of the CHAIRMAN, a very hearty vote of thanks was accorded to Mr. Nicol for his paper.

Joint Council of the Junior Gas Associations

The Annual Meeting of the Joint Council of the Junior Gas Associations was held in the Park Hotel, Cardiff, on Saturday, Oct. 13, 1934, under the chairmanship of Mr. B. J. BELL, of Cardiff.

The delegates attending were: Messrs. A. D. Howells (Wales and Monmouthshire), R. S. Snelling (Wales and Monmouthshire), T. K. Williams (Manchester and District), James Carr (Manchester and District), J. Alsop (Manchester and District), S. Hole (Western), K. C. Clark (Western), W. J. Pickering (Educational Representative), A. Hill (Midland), J. H. Wainwright (Midland), J. F. Rust (Newport), F. H. Higton (London and Southern), F. C. Smith (London and Southern), R. Halkett, Jnr. (Yorkshire), J. Firth (Yorkshire), B. Thorpe (Yorkshire), A. Bujnowski (Scottish Western), and H. J. Risby (Joint Secretary).

The CHAIRMAN (on behalf of the Wales and Monmouthshire Association) extended a welcome to the delegates.

The Minutes of the Meeting held at Birmingham on Oct. 23, 1933, having been circulated to the various Secretaries, were taken as read, and, on the motion of Mr. Snelling, seconded by Mr. Wainwright, they were approved and signed.

The SECRETARY and TREASURER then submitted his Annual Report and Balance-Sheet, which were approved. The reference in the report to the Joint Transactions was considered most satisfactory. It was decided that the Sub-Committee of Secretaries be continued to assist and advise in matters regarding the publication of the Joint Book, with Mr. Higton as Chairman.

Mr. RISBY intimated that his period of office terminated at this meeting, and that Mr. Alex. Bujnowski, Glasgow, had been nominated.

The Council unanimously agreed to place on record their appreciation of the valuable work done by Mr. Risby during his term of office.

Education Scheme Report.

Mr. PICKERING then submitted his report on the Education Scheme, in the course of which he said the Session 1933-34 was the eleventh in the history of the Education Scheme, and the year's work might be regarded as fairly satisfactory. The figures for the number of students who sat for examination in the Major Courses are very similar to the two previous sessions, and actually show an increase of 6% for 1934.

	1933.		1934.
External	105	..	131
Internal	312	..	315
Total	417	.	446

The figures for the Minor Courses and Gas Fitting are as follows:

	1933.		1934.
Gas-Works Practice	9	..	20
Gas Supply Practice	128	..	104
Total	137	..	124
Gas Fitting (total of all grades)	1,494	..	1,676

The total of all students examined this year under the Scheme is 2,246, as against 2,048 for 1933.

Comment was made last year on the difficulty experienced by some of the District Education Committees in securing a sufficient number of examiners for the Practical Examination in Gas Fitting, for which there is an increasing number of candidates; and the difficulty has been overcome this year by the City and Guilds holding the examination on two consecutive Saturdays instead of on one day as hitherto.

The fact that there are still practically no entries for the Diploma in Gas Supply is engaging the serious consideration of the Education Committee, and it is hoped to devise means of encouraging students to take this examination. It is a matter of some importance to the Industry, and is not altogether bound up with academic considerations.

The Report of the Board of Examiners has the usual adverse comments on certain aspects of the students' work, but it is gratifying to note that a "higher standard is being maintained in most grades" in the Major Courses. This agrees with the opinion of teachers at the larger centres that the calibre of the men shows a steady improvement.

The short course for teachers in Gas Engineering and Supply, under the auspices of the Board of Education, was held this year at the Westminster Technical Institute, London, from July 2 to 6. The course was again organized and conducted by Mr. C. H. Creasey, O.B.E., assisted by Dr. Thorne and Dr. Mason. (Dr. Thorne is Mr. Creasey's successor on the Education Executive Committee.) Of those attending this year 41% had not attended the course previously.

There are now 46 Centres with approved Major Courses, and 7 new Courses were approved during the year; while as regards Minor Courses and Gas Fitting 6 new Courses have been approved.

The Education Committee's Report comments on the fact that 5 of the Major Courses Centres "have not this year or in previous years submitted candidates," and remarks that this is not due to the absence of educational facilities. It may not be possible to hold classes in the main subjects, but instruction in ancillary subjects can be obtained at all the approved Centres, for the help of external students, and it would seem that the gas undertakings concerned in these areas might help more than at present. The District Education Committees appreciate the difficulties which obtain in this regard.

The next edition of the Education Scheme Regulations will include a comprehensive index. One of the amendments made during the year is an important one concerning entry to the Diploma Examination in Gas Engineering (Supply), and allows candidates to take, at their discretion, an additional ancillary subject of standard and character approved by the Gas Education Committee, instead of the Ordinary Grade Examination in Gas Engineering, as one of the qualifying examinations for entry to the Supply Diploma.

In conclusion, thanks are again due to all those concerned with the administration of the Scheme, while all desire to tender special thanks to Mr. Creasey on his retirement from the Board of Education. The Institution of Gas Engineers have wisely recognized the value of his past work in connection with the scheme by electing him to a seat on the Education Committee.

The report was adopted, and Mr. Pickering was warmly thanked for his work on the Committee.

British Industries Fair, Birmingham, 1934.

At the invitation of the Birmingham Chamber of Commerce the members of the Joint Junior Gas Associations attended the British Industries Fair, Birmingham, on Thursday, Feb. 22, 1934. Some 300 members attended the complimentary luncheon, and among those present were Mr. Percy Plant, the President of the Birmingham Chamber of Commerce, Mr. C. Valon Bennett, then Senior Vice-President of the Institution of Gas Engineers, the Senior Officials of the Birmingham Corporation Gas Department, and many distinguished overseas visitors. Mr. Percy Plant proposed the toast of "The Visitors," and to this Mr. Bennett responded. Following luncheon, an inspection of the exhibits was made. There will be no 1935 Fair.

In adopting the report it was agreed to place on record appreciation of the work done by Mr. Higton.

The formation of the British Gas Federation was discussed, and it was decided to express the co-operation of the Council. The Council decided that, if possible, the Juniors, who numbered 1,500, should be identified with the scheme, and authorized the President, Mr. Howells, and the Secretary to attend the Inaugural Dinner on Nov. 5 in London.

Mr. CLARK, on behalf of the Western Junior Association, extended a welcome to the Council to hold the next meeting in thir area, and the meeting concluded with the expression of appreciation to Mr. Bell for his chairmanship.

Luncheon.

The meeting was followed by luncheon, at which Mr. MADDEN, M.Inst.C.E. (Engineer and Manager, Cardiff Gas Light and Coke Company), presided. In extending welcome to the delegates, he referred to the work of the Juniors, and outlined the history of the Wales and Monmouthshire Association, and showed the very keen interest taken by the Seniors in the Juniors in Wales. The present position and competition were not to be feared, and he urged the Juniors to go forward and continue the campaign fearlessly.

Mr. ALSOP proposed a vote of thanks to Mr. Madden, and Mr. R. J. Auckland (Secretary of the Cardiff Company), Mr. J. H. Canning (Newport), Mr. Bell, Mr. Clark Jackson (Neath), and Mr. Octavius Thomas were also present and addressed the Juniors.

Following the lunch the members were conveyed by motor coach around various places of interest, and tea was provided at Penarth.

Perspective in Carbonizing Costs

By F. B. Richards, M.Inst.C.E., M.Inst.Gas E., M.I.Mech.E.

[A Paper before the Eastern Counties Gas Managers' Association, Oct. 25, 1934.]

To the gas engineer autumn is probably the most important season of the year. Shorter days and colder weather spell increased demand for gas and coke. It is the time when the manufacturing machine is put under steadily increasing load and when questions as to the relative merits of different methods of gas production naturally come to the fore.

It may, therefore, be fitting at this Autumn Meeting of your Association to endeavour to discuss the subject of perspective in carbonizing costs.

Pressure of work and concentration upon detail sometimes have the effect that one is too close to a particular set of facts to view the whole subject in true perspective. In gas production this is particularly so. A large number of variables influence the final result. Many of these are outside the control of the gas engineer; but unless a correct perspective is kept as to the influence of the various factors affecting cost of gas production, one may unwittingly be travelling in an entirely wrong direction.

The object of this paper, therefore, is to survey the problem of gas production in a general way, unassociated with particular local conditions, in the hope of enumerating a number of facts and tendencies which may be of use to the members of this Association in their particular applications. Here let me say that, although the phrase "carbonizing cost" is used in the title of the paper, it is intended to embrace the general subject of carbonization and water gas production, whether the latter is made in the carbonizing plant or externally in separate water gas machines.

Some six years ago my colleague, Dr. E. W. Smith, presented to the Second International Conference on Bituminous Coal at Pittsburgh a paper entitled "A Study of Comparative Costs of Gas Production in the Retort House."* One of the underlying principles of this paper was the need for a better perspective in the assessment of carbonizing costs. In the intervening period a number of improvements in connection with continuous vertical retort design have been effected, and also much more information on the results obtainable from intermittent vertical chambers has been collected.* Further, there have been changes in the basic figures upon which the calculations were originally made. New tables relating to these two types of carbonizing plant have therefore been prepared, based on 1934 data, and their scope extended.

Horizontal retorts have been excluded from this study, because one is not in possession of precise information upon which to base the calculations. For the sake of convenience, the tables and basic data of the calculations are assembled at the end of the paper in the form of an Appendix. From these tables it is possible to draw a number of interesting deductions.

In case there are some who fear that these somewhat academic tables are likely to prove uninteresting, one may perhaps be permitted to anticipate one of the conclusions. When assessing the influence of various factors it is useful to have certain parity values in mind—

Thus: 25% more fuel into the producers,
77% more labour on the carbonizing plant,
26% more capital expended,
$\frac{3}{4}$d. less per gallon of tar made,
and 11d. less per ton of coke sold,

each have the same quantitative effect on the cost of gas production when making 500 B.Th.U. gas in continuous vertical retorts on the basis set out in this paper. This may be taken as a typical result of applying the principle of permutations in search of perspective.

Continuous Vertical Retorts.

Tables 1 to 6 relate to various aspects of carbonization in continuous vertical retorts which may be summarized as follows:

(*a*) Influence of variation in calorific value.
(*b*) Influence of throughput.
(*c*) Influence of coal/coke price ratio.
(*d*) Influence of breeze burning.

* "GAS JOURNAL," Dec. 26, 1928.

Although the calculations are made for an installation with a normal capacity of 15,000 therms per day, the deductions will be found to be applicable to smaller installations, with the possible exception that capital and labour charges have a greater significance in such cases.

Broadly speaking, when dealing with any particular coal it is found that a modern continuous vertical retort can do a definite maximum amount of work in the production of gaseous therms per day. In other words, over the range of calorific values generally declared, therms per retort per day are found to be constant. Seeing that the amount of fuel consumed in the producers to keep the setting at full capacity is more or less constant, it follows that the fuel requirements are approximately constant per therm of gas made. Thus when steaming to make lower calorific value gas, with consequent increase in volume of gas per ton of coal carbonized, although the percentage of producer fuel used per ton of coal increases, there is no increase in weight of producer fuel per therm of gas made. With continuous vertical retorts it is also found that the tar make per therm of gas is very nearly constant on any given coal.

Seeing that labour and capital charges are related to plant size, and that thermal output per retort does not vary with variation in calorific value, it follows that the under-mentioned factors may be regarded as constant per therm of gas made, when the retort is working at any given load irrespective of the calorific value of the gas:

Labour.
Fuel.
Capital Charges.
Tar Credit.

This will become apparent in Table 1 which studies the influence of calorific value on cost of gas production.

The calculations are based on a number of assumptions which are set out immediately before the table. A few comments may be necessary by way of explanation. The yields, throughputs, &c., are based on the use of a good quality gas coal such as South Yorkshire screened coal which is capable of being efficiently steamed in continuous vertical retorts. In assessing the value of the coke made for sale, a correction is made for the percentage of breeze which it contains. Steam production from the surplus heat leaving the settings is considered in the steam balance given in Table 2. Seeing that in every case the surplus steam per therm (after providing for retorts and producers) is less than that normally required in the operation of a gas-works, credit is taken for this steam at 20d. per 1,000 lbs., which is suggested as a reasonable figure for the all-in cost of steam raised in solid fuel-fired boilers by which means the steam would otherwise have had to be raised. The capital cost item includes foundations, carbonizing plant, waste-heat boilers, coal and coke handling plant within the retort house, and the retort house building. The capital cost figure is based on a typical 15,000 therms per day installation and is calculated on the net capacity of the plant—that is, making allowance for retorts off for scurfing. The capital charges are based on the total figure of 12% per annum which is put forward as an adequate figure to cover interest on capital (5%), sinking fund (3%), and maintenance (4%). In this connection, maintenance is defined as the sum of money which has to be expended per ton of coal carbonized to keep the carbonizing plant in first-class running repair for an indefinite period.

It is further to be noted that all these costs relate to retort house cost of gas production and do not take into consideration costs of gas treatment, purification, storage, &c.

Table 1 shows the comparative costs of gas production when making gas of various calorific values from Yorkshire screened coal in continuous vertical retorts. It is assumed that the retorts are being worked to give maximum therms per retort per day. It will be noted that over the range 500 to 450 B.Th.U. the retort house cost of production per therm is very nearly the same, but with a tendency for the lower calorific value gas to be the cheaper. Above 500 B.Th.U. it will be observed that the cost rises by reason of the fact that there is a certain maximum

throughput for a given coal which is usually reached when making gas of about 500 B.Th.U., and therefore above this calorific value therms per retort per day fall off.

Having said that the retort house cost per therm when making 450 B.Th.U. gas works out slightly cheaper than when making 500 B.Th.U. gas, it is, however, to be remembered that the costs on the rest of the works (purification, &c.) are dependent on volume of gas, and that 450 B.Th.U. gas occupies over 10% greater volume per therm than 500 B.Th.U. gas. This factor alone probably absorbs the whole of the apparent difference.

Examination of the figures in Table 1 shows that the price ratio between coal and coke is the dominant influence on variation of cost of gas production. This is brought out in Table 5.

When coal is costing 22s. per ton, if the average price realized per ton of coke and breeze rises from (say) 18s. 3d. to 20s., it has an influence of 0·141d. per therm, while if the average price of coke and breeze rises to the same price as that of coal, then there is a reduction in cost of gas per therm from 1·688d. to 1·384d. It is to be further noted that as the price of coke rises the attraction of making increased quantities of water gas in the retorts disappears.

Table 2 gives the steam balance for continuous vertical retorts at varying calorific values, the quantity of surplus steam falling as the calorific value of the gas falls.

Table 3 sets out the facts (which are now almost axiomatic in their general acceptance) that it is more profitable to work a plant at maximum therms per retort per day rather than to seek for the last therm per ton at the cost of reduced throughput and higher labour, fuel, and capital charges.

The Economics of Breeze Burning.

The great importance of the coal/coke price ratio naturally leads one to the consideration of the question of using a lower grade fuel in the producers. In the past two or three years the burning of breeze in step-grate producers has become a technical success, and therefore a consideration of the economic advantages of this development will not be out of place.

When using coke from Yorkshire coal it is found that 45% of the producer fuel can be below ⅝ in. When coke is worth 20s. per ton at works and breeze 5s. per ton and allowing 12% breeze in the coke, the average value of the run-of-make coke is 18s. 3d. per ton. If, however, producer fuel is used containing 45% breeze, then the value of producer fuel is only 13s. 3d. per ton. Obviously the higher the value of coke the greater is the saving by the use of low grade producer fuel.

On the other side of the balance-sheet there are the costs associated with breeze burning, which may be summarized as increased grate area, increased steam consumption per lb. of fuel gasified, and increased labour cost (which is approximately proportional to the grate area).

An attempt has been made to assess these advantages and disadvantages in Table 6. This shows that the saving in fuel more than offsets the extra capital and labour charges. By burning breeze for 12 months on a 3 million c.ft. per day plant it is seen that a saving of from £1,350 to £2,000 could be made under the conditions indicated.

We may thus summarize our deductions in connection with continuous vertical retorts:

(1) The cheapest gas is made when retorts are worked at their maximum thermal output per retort per day.
(2) The leading influence on cost of manufacture is the price relationship between coal cost and returns for coke and tar.
(3) For a coal which is amenable to steaming there is little difference in the retort house cost of gas production over the range 500 B.Th.U. to 450 B.Th.U., but the lower the value for coke, the more the attraction to make low calorific value gas. Against the retort house saving with low calorific value gas must be offset the increased works cost.
(4) Breeze burning by reducing the fuel cost is a paying proposition.
(5) Labour cost represents less than 8% of the final cost of gas *ex* retort house. It is easy by excessive cutting in labour schedules and consequent reduction in general plant efficiency to increase cost of production.

Intermittent Vertical Chambers.

In Tables 7 and 8 are given the comparative costs of gas production when making gas of varying calorific values in intermittent vertical chambers. In general the calculations follow similar lines to those for continuous vertical retorts.

It will be observed from Table 7 that as the calorific values fall below or rise much above 520 B.Th.U. per c.ft. the cost per therm of gas increases. It may be of interest to compare these figures on Table 7 with the similar figures on Table 1 for continuous vertical retorts.

It is to be noted that both tables relate to the carbonization of South Yorkshire screened coal.

The following observations may be made:

(1) At 520, 500, and 475 B.Th.U. intermittent vertical chambers make more therms per ton than continuous verticals, but as the calorific value falls this advantage disappears. The advantage at high calorific values is due to the better cracking of the primary products with the static charge. The loss of this advantage at lower calorific values is due to the fact that with prolonged steaming the quality of water gas from intermittent vertical chambers falls progressively, whereas that from continuous vertical retorts remains approximately constant.
(2) Whereas output in therms of the continuous vertical retort plant remains approximately constant with reduction in calorific value, with intermittent vertical chambers the thermal output falls off at lower calorific values. This is probably accounted for by the fact that in continuous vertical retorts water gas production is continuous, and the hot water gas performs some useful work in carbonization. In intermittent vertical chambers water gas is only made after the charge is coked, and therefore has little effect on carbonization.
(3) Fuel consumptions are shown slightly higher for intermittent vertical chambers than for continuous verticals. It must be pointed out, however, that the modern continuous vertical retort plant is usually non-recuperative, giving a high yield of steam in the waste-heat boilers, whereas the intermittent vertical chamber plant, as usually installed to-day, is a recuperative setting giving a lower yield of surplus steam. With the same degree of recuperation intermittent vertical chambers must of necessity have a higher fuel consumption than continuous verticals, since the coke leaves the chambers at high temperatures.
(4) Labour costs are found to be slightly lower with intermittent vertical chambers than with continuous vertical retorts.
(5) Capital costs of intermittent vertical chambers are slightly higher than those of continuous verticals.
(6) Taking these various facts into consideration it is found that the cost per therm is slightly higher when making gas of any given calorific value in intermittent vertical chambers than in continuous vertical retorts. At 500 B.Th.U. the respective figures are 1·929d. and 1·688d. per therm.

It may be argued that by taking Yorkshire screened coal one has set down conditions unduly in favour of continuous verticals. Therefore calculations have been made for both continuous vertical retorts and intermittent vertical chambers on Durham run-of-mine coal as set out in Table 9. These conditions are the more favourable to intermittent vertical chambers.

Durham run-of-mine, when used in place of Yorkshire screened coal, has the following effect on results from continuous vertical retorts:

Reduces throughput, therms per ton, tar yield, and therms per retort per day.

Increases fuel consumption, capital cost, labour cost, and surplus steam.

On the other hand with intermittent vertical chambers Durham coal has the following effects:

Reduces fuel consumption and capital charges.

Increases throughput and therms per chamber per day.

In view of the above it is to be expected that the use of Durham coal in place of Yorkshire coal (taken at the same basic price as in calculations for Yorkshire coal—22s. per ton) causes a *fall* in price of gas from intermittent verticals and a *rise* in price of gas from continuous verticals. But even so, when using Durham coal the cost per therm from continuous retorts is slightly less than that from intermittent vertical chambers.

A point which may cause comment—and should be mentioned in passing—is the method of assessing maintenance cost of continuous vertical retorts and intermittent vertical chambers. Maintenance cost is influenced by such factors as nature of coal, calorific value of gas, costs of materials and labour. There is available to-day far less information on maintenance cost under British conditions for intermittent vertical chambers than for continuous vertical re-

torts, and it is difficult to assess their ultimate comparative maintenance costs. In default of more precise information maintenance costs for both types of installation have been expressed in terms of a percentage (4%) on the capital value of the carbonizing plant, which figure will, it is believed, prove adequate. But in order to assess any possible error due to this assumption, it may be noted that a 25% *greater* maintenance cost of one system over the other only influences the final net cost per therm by 0·030d.

To maintain a true perspective of the comparative costs of gas production in continuous vertical retorts and intermittent vertical chambers, it is necessary to observe that the retort house cost of gas production does not account for more than 25% to 33% of the selling price of gas. Further it has been shown that there is relatively little difference in the cost of gas production from these two types of plant under similar conditions. Therefore other factors, such as nature of coal available, type of coke required, calorific value of gas required, size of installation, and local amenities, usually play a predominant part in the selection of new plant.

The Significance of Benzole Recovery.

At a time when benzole recovery is attracting so much attention, both as a profit maker and as a factor of national significance, one can hardly omit a few notes on this subject in relation to the economics of gas production.

In any calculations on benzole recovery it is usually assumed that "1 gallon crude benzole produced = 40 c.ft. = 1·46 therms." It is, however, necessary to keep in mind that—particularly with steamed vertical retorts—therms per ton are dependent on the presence of the "enrichers" (such as ethylene, benzene, methane, &c.). The poorer the quality of these enrichers the greater must be the care in assessing the economic value of benzole recovery.

For example, with Scotch coal there is usually a lack of "enrichers;" hence the lower thermal yield per ton of coal as compared with English coal. If with a declared calorific value of (say) 475 B.Th.U. it be decided to wash the gas for benzole to the extent of 2 gallons per ton, it will be necessary to make gas of about 495 B.Th.U. with *probably* disproportionate loss in therms per ton.

The extent to which benzole washing affects therms per ton, especially at lower calorific values, is not sometimes appreciated. To take an example, assume that an undertaking operating continuous vertical retorts is making 460 B.Th.U. gas and carbonizing Yorkshire nuts. The effect of producing 2 gallons of benzole by washing the gas while maintaining the calorific value is to reduce the therms per ton of coal from 90 to 82 and to render approximately 14% more coke available for sale for a given daily thermal output.

Broadly speaking, therefore, for an existing set of conditions with continuous vertical retorts, the best return from benzole washing follows a reduction in declared calorific value of gas rather than a rise in the calorific value of the unstripped gas. No generalizations can be made on this matter, and it is suggested that before embarking on benzole recovery detailed calculations should be made covering such items as effect on therms per ton, throughput, plant output, and coke for sale.

If one may be permitted to sum up this aspect in a lighter vein, it may be suggested that benzole recovery can best be applied in the slimming of a "fat" therm and is of little value in the case of a "lean" therm.

With intermittent vertical chambers the position is slightly different. The "straight gas" from this type of plant has a higher calorific value than that from continuous vertical retorts when using the same coal, and therefore lends itself better to stripping. Further, steaming down the calorific value of the gas in intermittent vertical chambers is less economically satisfactory than in continuous vertical retorts. For example, it can be shown that the final cost per therm of 500 B.Th.U. gas is slightly cheaper when making 520 B.Th.U. gas in the chambers, benzole washing down to 500 B.Th.U. and delivering a final yield of 75 therms per ton from Durham run-of-mine coal than when steaming the gas in the chambers down to 500 B.Th.U., neglecting benzole washing and delivering a final yield of 82 therms per ton. Here, again, an extra 13% coke for sale becomes available for a given daily thermal output of gas.

To sum up, benzole recovery is attractive in that the sale of the crude spirit or finished product brings a new and tangible cash return. The losses, when they occur, are merged into the cost of gas production. Provided that coke market, type of coal, type of plant, and declared calorific value of gas are suitable, benzole recovery may materially reduce the cost of gas. But, as already mentioned, it is a subject upon which generalizations can be highly misleading and only specialized consideration of local conditions can supply the correct answer in each case. One has not been considering benzole recovery from the point of view of national importance. It is appreciated that at any time this may overrule purely economic considerations.

Carburetted Water Gas as a Coal Gas Auxiliary.

A little over twelve months ago there appeared in the "GAS JOURNAL"* a very able and convincing exposition on the subject of carburetted water gas as a coal gas auxiliary. Coming as it did from the firm whose name is synonymous with water gas in this country—Messrs. Humphreys & Glasgow, Ltd.—the articles commanded attention and respect. But, as was remarked in Editorial comment, some of the conclusions were so startling that it was thought that the contribution would "cause more than a flutter in gas engineering circles."

One has waited in vain for a statement of the "opposite side" of this fascinating subject. Taking into consideration the source of the articles, it was only natural that the best case possible would be made out for water gas. True perspective on this matter is of great importance to the Gas Industry, and therefore one has ventured to consider the matter from the angle of one who is associated with coal carbonization. Between these two differing viewpoints our friends in the Gas Industry may safely be trusted to determine the *via media*.

To refresh your memory, in the articles above-mentioned it was shown—

(1) that "peak-load" carburetted water gas is cheaper to manufacture than coal gas *per se*—*i.e.*, carrying the whole load; that including works capital charges, peak-load carburetted water gas costs only three-fifths of the cost of peak-load coal gas for the same service;

(2) that the whole new duty of 1d. per gallon on all gas-oil used in Great Britain is but a small fraction of the reflex benefits of carburetted water gas in the gas coal and residual markets;

(3) that the advantages of carburetted water gas as a coal gas auxiliary are permanent.

Dealing with the last point first, it would be both futile and ungenerous to deny the important and permanent place which carburetted water gas holds as an auxiliary to coal gas production. One's criticisms will be directed to some of the statements in support of carburetted water gas production which, through over-enthusiasm, have, it is suggested, lost their true perspective.

For the understanding of this argument it will be necessary to repeat the comparative works costs included at the end of Part I. of the articles under review. It will be remembered that the calculations are based on a works with an annual output of 4,000 millions of 500 B.Th.U. gas, of which 80% of the annual output is taken as base-load gas and 20% as peak-load gas.

(1) *Coal Gas per se*

[*i.e.*, carrying the whole load].

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear . . .	10·60	2·12
Wear and tear	4·00	0·80
Capital charges.	5·40	1·08
WORKS COST COAL GAS *per se*	20·00	4·00

(2) *Coal Gas for Peak-Load.*

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear . . .	11·37	2·27
Wear and tear	8·57	1·71
Capital charges	12·73	2·55
WORKS COST OF COAL GAS FOR PEAK-LOAD .	32·67	6·53

* "GAS JOURNAL," Aug. 23 and 30, 1933.

(3) *Coal Gas for Base Load.*

	Pence	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear . . .	10.41	2·08
Wear and tear	2·86	0·57
Capital charges	3·57	0·71
WORKS COST OF COAL GAS FOR BASE-LOAD .	16·84	3·37

(4) *Carburetted Water Gas for Peak Load.*

	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear . . .	12·80	2·56
Wear and tear	1·50	0·30
Capital charges	5·66	1·13
WORKS COST OF C.W.G. FOR PEAK-LOAD . .	19·96	3·99

(5) *Carburetted Water Gas per se.*

	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear . . .	12·43	2·49
Wear and tear	1·40	0·28
Capital charges	2·70	0·54
WORKS COST OF CARBURETTED WATER GAS .	16·53	3·31

The following comments are put forward relating to the various items:

***Plant Capacity.*—Consideration of the annual output chart shows that the maximum week is 114 millions (the average daily make during this week being 16·25 millions). The maximum day's output is given as 18 millions and lasts for one day. To meet these conditions a plant with a total rated capacity of 20 millions is made available. One suggests in the first place that a plant with a capacity of 18 million c.ft. per day is adequate. Even with a plant of this size the**

$$\text{Percentage. . . . .} \quad \frac{\text{Annual output}}{\text{Rated capacity}} = 60$$

Seeing that the capital cost of a carbonizing plant is appreciably higher than that of a C.W.G. plant of similar capacity, to provide unnecessary plant in a calculation of this nature operates to the disadvantage of coal gas manufacture.

***Capital Costs.*—The relative capital costs of coal gas plant and C.W.G. plant are of considerable importance in a comparison of their merits. In the articles under consideration the capital cost of a 20,000,000 c.ft. per day works excluding holders was taken at the rate of £45,000 per million for coal gas and £22,500 per million for carburetted water gas *per se*. The former figure appears excessive for a 20 million works in the light of available information. Probably the most authoritative figure published is that of Mr. T. Hardie,* who gave the total capital cost of modern works as £35,000 per million, excluding holders. This latter figure is much more relevant to a large installation.**

***Wear and Tear.*—Coal gas production is charged with 4d. per 1,000 c.ft. for wear and tear when the total 4,000 million c.ft. is from this source. This figure obviously covers two items, costs associated with maintenance of the carbonizing plant and costs associated with maintenance of the rest of the works. The latter item is substantially constant irrespective of the type of gas production plant. Fourpence per 1,000 c.ft. represents a figure of over 5s. per ton of coal carbonized. If, therefore, the wear and tear figure is divided into two equal portions a very generous provision has been made for carbonizing plant maintenance, while the remaining 2d. is applied to general works maintenance. This procedure of sub-dividing wear and tear into two equal parts was, it will be remembered, applied to coal gas manufacture by Mr. George Evetts in his paper on "Economics of Gas Production" to the Institution of Gas Engineers, June, 1925.**

Water gas production *per se* is charged with a total wear and tear of only 1·40d.—a figure less than that above suggested for general works maintenance when coal gas only is made. Allowing the small figure of 0·5d. per 1,000 c.ft. for maintenance of the C.W.G. plant proper, the corresponding "all-in" figures are:

4d. with coal gas.
2·5d. with C.W.G.

* See Presidential Address to the Southern Association, 1927, "GAS JOURNAL" for April 6.

Wear and Tear: Peak-Load Coal Gas.

When dealing with the cost of coal gas under peak-load conditions in the articles under consideration, it is assumed that the peak-load wear and tear bears a 3 to 1 ratio to the base-load wear and tear. The reasoning underlying this is that a large amount of plant is assumed to be lying idle waiting just to take on a short peak-load, and therefore must bear a disproportionate amount of wear and tear per unit of gas made. If base-load plant never required repairs this might be so—although in this case the item maintenance cost would itself almost disappear.

But let us consider the practical case of an 18 million per day carbonizing plant with a base-load of 10½ million c.ft. On the assumption that a carbonizing plant requires to be let down for repairs at least every five years, then 3·5 million c.ft. per day naturally comes down every summer for this purpose. The increasing autumn load is to this extent taken up by a repaired unit put back into commission. It, therefore, may be argued that only those plants which are specifically put on and let down for a few months should bear disproportionate peak-load costs.

Arguing along these lines the comparative base-load and peak-load maintenance costs are as follows:

TOTAL CARBONIZING PLANT MAINTENANCE:
2d. × 4,000 millions . . . . = £33,300

BASE-LOAD:
$$\frac{14 \times £33{,}300}{18 \times 3{,}200 \text{ millions}} \quad . \ . \ . \ . = 1{\cdot}95\text{d. per 1,000 c.ft.}$$

PEAK-LOAD:
$$\frac{4 \times £33{,}300}{18 \times 800 \text{ millions}} \quad . \ . \ . \ . = 2{\cdot}22\text{d. } ,, \ ,, \ ,,$$

Treating the maintenance costs of the rest of the Works similarly we arrive at—

Totals of:
Base-load wear and tear . . = 3·90d. per 1,000 c.ft.
Peak-load wear and tear . . = 4·44d. ,, ,, ,,

Capital Charges.

It is necessary to allocate capital charges according to the base-load or peak-load sections. But here, again, it is nothing to do with peak-load gas when a base-load plant has to be repaired. In other words, to make 10½ million c.ft. per day indefinitely and to allow a plant six months off for repairs every five years it is necessary to allocate the capital charges of 11½ million c.ft. per day against base-load, leaving 6½ million c.ft. for peak-load capital charges.

Thus—

TOTAL CAPITAL CHARGES:
10% × £630,000 = £63,000

BASE-LOAD CAPITAL CHARGES:
$$\frac{11{\cdot}5 \times £63{,}000}{18 \times 3{,}200 \text{ millions}} \quad . \ . \ . = 3{\cdot}02\text{d. per 1000 c.ft.}$$

PEAK-LOAD CAPITAL CHARGES:
$$\frac{6{\cdot}5 \times £63{,}000}{18 \times 800 \text{ millions}} \quad . \ . \ . = 6{\cdot}82\text{d. } ,, \ ,, \ ,,$$

Additional Fuel and Labour for Peak-Load Coal Gas.

Calculations are given in the articles which show the extent to which the cost of peak-load coal gas and base-load coal gas is influenced by the need of standing retorts under heat ready for emergency. Although the provisions are on the generous side it has to be admitted there is a greater expense in standing carbonizing plant under fire than that associated with emergency C.W.G. plant.

The only modification suggested here relates to reducing the plant capacity from 20 million c.ft. to 18 million c.ft.

This gives manufacturing charges (less wear and tear) as follows:—

Base-load gas = 10·448d. per 1,000 c.ft.
Peak-load gas = 11·204d. ,, ,, ,,

We are now in a position to re-calculate the various tables on the above assumptions.

Re Calculated Figures.

Annual output	4,000 millions.
Maximum week (Average daily in max. week = 16·25 mill.)	114 millions.
Maximum day's output	18 millions (1 day).
Total daily maximum capacity	18 millions.
Percentage $\frac{\text{Annual output}}{\text{Rated capacity}}$ =	60%
Base-load	3,200 millions.
Peak-load	800 millions.
Base-load portion of plant	10·57 millions/day.
Peak-load portion of plant	7·43 millions/day.
CAPITAL COST— 18,000,000 at £35,00 /million =	£630,000.

(1) *Coal Gas per se.*

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost, *less* wear and tear	10·60	2·12
Wear and tear carbonizing plant	2·00	0·40
Wear and tear rest of works	2·00	0·40
Capital charges (10% on £630,000)	3·78	0·76
	18·38	3·68

(2) *Peak-Load Coal Gas.*

[800 million c.ft. on plant, 7·43 million c.ft. per day capacity.]

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing charges, *less* wear and tear	11·204	2·241
Wear and tear	4·440	0·888
Capital charges	6·820	1·364
Total	22·464	4·493

(3) *Base Load Coal Gas.*

[3,200 million c.ft. on plant, with 10·57 million c.ft. per day capacity.]

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing charges, *less* wear and tear	10·448	2·089
Wear and tear	3·900	0·780
Capital charges	3·020	0·605
Total	17·368	3·474

(4) *Carburetted Water Gas Peak-Load.*

[7·43 millions capacity, 800 millions per annum.]

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost	12·80	2·56
Wear and tear	2·74	0·55
Capital charges (10% on £148,600)	4·46	0·89
Total	20·00	4·00

(5) *Carburetted Water Gas per se.*

—	Pence.	
	Per 1,000 C.Ft.	Per Therm.
Manufacturing cost	12·43	2·49
Wear and tear	2·50	0·50
Capital charges (10% on £406,000	2·43	0·49
Total	17·36	3·48

Summarizing these revised figures, we find that peak-load carburetted water gas is more expensive to manufacture than coal gas *per se* (contrary to the original statement). We find that peak-load coal gas is slightly more expensive than peak-load carburetted water gas and that the combination coal gas base-load/carburetted water gas peak-load under the conditions given for an 18 million c.ft. per day works is 0·1d. per therm cheaper than an all-coal-gas works (compared with over four times this figure in the original statement).

Summary of Original and Revised Figures.

—	Original.		Revised.	
	500 B.Th.U.			
	Pence per 1,000 C.Ft.	Pence per Therm.	Pence per 1,000 C.Ft.	Pence per Therm.
Coal gas (*per se*)	20·00	4·00	18·38	3·68
Peak-load coal gas	32·67	6·53	22·46	4·49
Base-load coal gas	16·84	3·37	17·37	3·47
Peak-load C.W.G.	19·96	3·99	20·00	4·00
C.W.G. (*per se*)	16·53	3·31	17·36*	3·48
Coal gas base-load 3200 million / C.W.G. peak-load 800 million	17·46	3·49	17·90	3·58
Saving of combination over all coal gas	2·54	0·51	0·48	0·10

* 1d. per gallon on the price of gas oil puts this figure up to 19·36d. per 1,000 c ft.

An increase of 1d. per gallon on the price of oil would practically wipe out this advantage.

This reconsideration of the facts, therefore, shows that carburetted water gas will always take an important place as an auxiliary to coal gas production, but that there is no reason to believe that a supply of cheaper gas will be forthcoming from a substantial increase in its production.

The suggestion of a 4,000 million C.W.G. plant *per se* is not stressed in the original contribution, nor does one imagine that it would be regarded seriously for a large undertaking to be entirely dependent for its gas output upon the importation to the works of bought coke and foreign oil.

Importance of Coke and Tar.

The "reflex" benefits attributed to water gas production are based on the assumption that an extra supply of coke and tar from coal gas production would cause a "collapse" in prices, at any rate of the former bye-product.

We thus arrive at the same conclusion in each of the sections of this paper—coal gas production, benzole recovery, and water gas production—that the value of and the market for coke and tar are of supreme importance to the future development of the Gas Industry. Are we to accept that when 7½ million tons of gas coke is available for sale the market is approaching saturation and that a million or two more tons of coke will cause a "collapse" in price? Can this possibly be the case when over 40 million tons of coal are being used in domestic hearths alone? Are we to consider that tar markets are saturated when thousands of tons of imported bitumen are entering the country and when hydrogenation plants—a likely purchaser for tar—are coming into the realms of commercial probability?

It is suggested that a great deal more can be done by the Gas Industry in the stabilization and extension of the markets for both coke and tar. It appears that this line of endeavour may well have more far-reaching influence upon the production of cheap gas than any practicable trimming of labour schedules and economies in plant construction costs.

It is in this belief that one ventures to outline a few suggestions regarding the development of coke sales:

(1) *Market Research.*—In view of the importance of coke sales to the prosperity of the Gas Industry, one wonders whether enough attention is being paid to market research. For example, is it known in detail for what purposes, in what sizes, and with what results the 7½ million tons of gas coke is being used in industry and the home? To cite an example, would it not be possible for some official body—such as the Institution of Gas Engineers—to make, through the various gas undertakings (each working in contact with local building authorities), a survey of the probable future demand for coke and the nature of the coke required? In some parts of the country the coke boiler for domestic hot water is standard equipment even in the small house as built to-day. In other parts the kitchen range or parlour fire boiler is still popular. In the sale and distribution of gas the problems of London and Birmingham may be similar, but in coke sales they are entirely different. A correct understanding of local coke requirements should often

be the deciding factor in the choice of type of carbonizing plant.

(2) *Market Organization.*—Having determined what the consumer wants, it becomes necessary so to organize the distribution machinery that he may get his requirements. There is need for national co-ordination of coke sales, with due evaluation of such factors as standardization of nomenclature, burning properties, percentage of ash and moisture, and so on. While recognizing the obstacles that have to be overcome there seems a good case for co-operation between the gas and coking industries in the development of coke sales. Assuming that ten million tons of coke per annum are being disposed of in this country industrially and domestically, a difference of sixpence per ton represents £250,000 to the two industries. Has not the time come for some national body on the gas side to take up coke sales as its main work, this forming naturally the first step towards co-operation with the coking industry.

(3) *Improved Preparation.*—Coke preparation is today receiving much more attention than it used to. Proper quenching, handling without unnecessary breakage and proper screening, all have their influence on the final value of coke. A striking example of this can be quoted in connection with intermittent vertical chambers. A few years ago the coke from such a plant was regarded as difficult to sell, but it is now recognized that a first quality coke can be produced in vertical chambers if suitable steps be taken, including controlled quenching, the use of the natural smalls in the producers, and the cutting for sale of the large low-moisture coke, coupled with the use of gas coal of low ash content.

(4) *Technical Research.*—Are we satisfied that adequate attention is being paid to the design of the apparatus in which coke is to be burnt? Surely we must admit that the average coke burning boiler installed for domestic use is anything but efficient with the constantly varying condition of its fuel bed. Would not co-ordinated research into these matters yield a handsome return on the investment?

Tar.

Similarly with tar, one cannot help feeling that there is a tendency on the part of many people to class tar as a "bye-product" of relatively little importance. Yet as has already been mentioned it is of more importance to devise a scheme for increasing the revenue from tar by 1d. per gallon than to endeavour to reduce the carbonizing labour by 60%. Is it not well within the bounds of possibility that we shall see an extension of the proper treatment of tar at the gas-works, providing from the distillation residues a road tar or tar emulsion for local use and making available the distillates for supply to centralized hydrogenation plants for conversion into motor spirit? In view of the great importance that tar has on gas production costs, we should use every endeavour and watch every possibility of raising the value of crude tar.

In conclusion, our study of perspective in carbonizing costs may perhaps be summed up into a sentence which we may well regard as a resolution for the coming winter—"Work the carbonizing plant to give maximum thermal output per unit; staff the plant adequately; watch fuel consumption especially; keep an eye on coal quality; and, most important of all, give the development of coke and tar sales special consideration."

This paper—like all other "W-D." products—is the result of team work, and I take this opportunity of acknowledging my indebtedness to various members of my staff and in particular to Mr. T. C. Finlayson.

APPENDIX.

Comparative Costs of Gas Production.

Continuous Vertical Retorts.

Comparative Costs of Gas Production at Varying Calorific Values.

(See Table 1.)

Assumptions Made—

Size of plant = 15,000 therms per day.
Coal—Good quality gas coal such as S. Yorkshire screened.
Coal cost = 22s. ton.
Coke value = 20s. ton.
Breeze value = 5s. ton.
Percentage breeze made per ton coke, 0 – ⅝ in. = 12%.
Value of coke *plus* breeze per ton as made = 18s. 3d.
Tar value (crude) = 2½d. per gallon.
Surplus steam value = 20d. per 1,000 lbs.

Capital Cost of Plant (making allowance for scurfing retorts) when making 500 B.Th.U. gas = £260 per ton throughput per day or £3·25 per therm per day.

Capital Charges allowing for interest, sinking fund and maintenance = 12% per annum.

Working days per annum = 250.
Labour rated at 11s. 6d. per shift.
Number of men = 14.

Table 1.—*Continuous Vertical Retorts.*

Comparative Costs of Production at Varying Calorific Values.

Case	A	B	C	D
Calorific Value, B.Th.U. per c.ft.	520	500	475	450
Throughput—tons per inch major axis of retort per day	0·104	0·104	0·097	0·088
Therms per ton	75·6	80·0	86·0	94·0
Tar, galls. per ton	11·0	12·0	13·0	14·0
Dry fuel, % on weight of coal	13·75	13·75	14·8	16·2
Gross coke make with 5% H_2O (% on weight of coal)	70·0	69·0	67·5	65·5
Comparative thermal output per retort per day (500 B.Th.U. gas = 100%)	94·5	100	100	100
	All Figures Pence per Therm.			
Coal cost	3·492	3·300	3·070	2·808
Labour	0·137	0·129	0·129	0·129
Fuel	0·419	0·395	0·395	0·395
Capital	0·396	0·374	0·374	0·374
Total	4·444	4·198	3·968	3·706
Less—				
Gross coke	2·028	1·889	1·719	1·526
Tar	0·364	0·375	0·375	0·375
Surplus steam	0·297	0·246	0·215	0·191
Total credit	2·689	2·510	2·309	2·092
Net Cost per Therm	1·755	1·688	1·659	1·614

Table 2.—*Steam Balance. Continuous Vertical Retorts.*

Variation in Calorific Value.

Case	A	B	C	D	BB
Calorific Value, B.Th.U.	520	500	475	450	500
Throughput, tons per inch major axis per day	0·104	0·104	0·097	0·088	0·104
Therms per ton	75·6	80·0	86·0	94·0	80·0
Dry fuel, % on weight of coal	13·75	13·75	14·8	16·2	13·75
Lbs. dry fuel per therm gas	4·07	3·85	3·85	3·85	3·85
Gross steam made per therm (after deducting that used for fan and boiler feed pump)	18·72	17·71	17·71	17·71	17·71
Steam for steaming retorts, lbs. per therm	2·67	4·20	5·81	7·00	4·20
Steam for producers, lbs. per therm	1·20	1·15	1·15	1·15	2·88
Net surplus steam, lbs. per therm	14·85	12·36	10·75	9·56	10·63
Value of surplus steam at 2od. per 1,000 lbs., pence per therm	0·297	0·246	0·215	0·191	0·213

Table 3.—*Continuous Vertical Retorts.*

Comparative Cost of Production at Various Throughputs.

Case	B	B[X]	B[Y]
Calorific Value, B.Th.U.	500	500	500
Throughput, tons per inch major axis per day	0·104	0·098	0·092
Therms per ton	80·0	81·0	82·0
Tar, galls. per ton	12·0	12·0	12·0
Dry fuel, % on weight of coal	13·75	14·5	15·25
Gross coke make with 5% H_2O (% on weight of coal)	69·0	68·75	68·5
Comparative thermal output (500 B.Th.U. gas at maximum throughput = 100%)	100	95·5	90·6
	All Figures Pence per Therm.		
Coal cost	3·300	3·260	3·220
Labour	0·129	0·135	0·142
Fuel	0·395	0·412	0·427
Capital	0·374	0·394	0·413
Total	4·198	4·201	4·202
Less—			
Gross coke	1·889	1·865	1·842
Tar	0·375	0·370	0·365
Surplus steam	0·246	0·262	0·274
Total credit	2·510	2·497	2·481
Net Cost per Therm.	1·688	1·704	1·721

TABLE 4.—*Steam Balance. Continuous Vertical Retorts.*

Variation in Throughput.

Case	B	Bx	Bv
Calorific Value, B.Th.U.	500	500	500
Throughput—tons per inch, major axis per day	0·104	0·098	0·092
Therms per ton	80	81	82
Dry fuel, % on weight of coal	13·75	14·5	15·25
Lbs. dry fuel per therm gas	3·85	4·02	4·17
Gross steam made per therm (after deduction for fan and boiler feed pump)	17·71	18·50	19·20
Steam for steaming retorts, lbs per therm	4·20	4·20	4·20
Steam for producers, lbs. per therm	1·15	1·21	1·27
Net surplus steam, lbs. per therm.	12·36	13·09	13·73
Value of surplus steam at 20d. per 1,000 lbs., pence per therm	0·246	0·262	0·274

TABLE 5.—*Continuous Vertical Retorts.*

Effect of Coal/Coke Ratio on Cost of Gas Production.

Scheme	B	D	B_1	D_1	B_2	D_2
Calorific Value, B.Th.U.	500	450	500	450	500	450
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Coal cost	22 0	22 0	22 0	22 0	22 0	22 0
Average price realized per ton coke and breeze	18 3	18 3	20 0	20 0	22 0	22 0
Basic data as Table 1						
	All Figures Pence per Therm.					
Coal cost	3·300	2·808	3·300	2·808	3·300	2·808
Labour	0·129	0·129	0·129	0·129	0·129	0·129
Fuel	0·395	0·395	0·435	0·435	0·477	0·477
Capital	0·374	0·374	0·374	0·374	0·374	0·374
Total	4·198	3·706	4·238	3·746	4·280	3·788
Less—						
Gross coke	1·889	1·526	2·070	1·672	2·275	1·840
Tar	0·375	0·375	0·375	0·375	0·375	0·375
Surplus steam	0·246	0·191	0·246	0·191	0·246	0·191
Total credit	2·510	2·092	2·691	2·238	2·896	2·406
NET COST PER THERM	1·688	1·614	1·547	1·508	1·384	1·382

Continuous Vertical Retorts.

Effect of Breeze Burning on Cost of Production.

(See Table 6.)

ASSUMPTIONS (generally as explained for Table 1)—

Calorific value of gas = 500 B.Th.U. per c.ft.
Size of plant = 15,000 therms per day.
Coal = good quality gas coal such as S. Yorkshire screened.
Coal cost = 22s. ton.
Coke value = 20s. ton.
Breeze value = 5s. ton.
Percentage breeze made per ton coke (0 – ⅝ in.) = 12%.
Tar value (crude) = 2¼d. per gallon.
Surplus steam value = 20d. per 1,000 lbs.

CAPITAL COST OF PLANT—

Without breeze burning, £3·25 per therm per day.
With breeze burning, £3·30 per therm per day.

CAPITAL CHARGES (interest, sinking fund, maintenance), 12%.

BREEZE BURNING—

Percentage breeze (0 – ⅝ in.) in producer fuel = 45%.
Total make breeze per ton coal carbonized = 1·66 cwt.
Total fuel required per ton coal carbonized (13·75%) = 2·75 cwt.
Of this 45% is breeze = 1·24 cwt.
Surplus breeze = 0·42 cwt.
Producer fuel value per ton = 13s. 3d.
Fuel cost per therm gas = 0·287d.

LABOUR = 25% more labour on producers.

TABLE 6.—*Continuous Vertical Retorts.*

Effect of Breeze Burning on Cost of Production.

Case	B	BB.	B_2	B_2B
	500 B.Th.U. Normal.	500 B.Th.U. Breeze Burning.	500 B.Th.U. Normal.	500 B.Th.U. Breeze Burning.
	s. d.	s. d.	s. d.	s. d.
Coal cost	22 0	22 0	22 0	22 0
Coke value per ton made	20 0	20 0	24 4	24 4
Breeze value per ton	5 0	5 0	5 0	5 0
Average value coke and breeze as made	18 3	18 3	22 0	22 0
Value of producer fuel per ton	18 3	13 3	22 0	15 6
	All Figures Pence per Therm.			
Coal cost	3·300	3·300	3·300	3·300
Labour	0·129	0·137	0·129	0·137
Fuel	0·395	0·287	0·477	0·336
Capital	0·374	0·380	0·374	0·380
Total	4·198	4·104	4·280	4·153
Less—				
Gross coke	1·889	1·889	2·275	2·275
Tar	0·375	0·375	0·375	0·375
Surplus steam	0·246	0·213	0·246	0·213
Total credit	2·510	2·477	2·896	2·863
NET COST PER THERM	1·688	1·627	1·384	1·290

Intermittent Vertical Chambers.

Comparative Costs of Gas Production at Varying Calorific Values.

(See Table 7.)

BASIC ASSUMPTIONS—

Size of plant = 15,000 therms per day.
Coal = Good quality gas coal such as S. Yorkshire screened.
Coal cost = 22s. ton.
Coke value = 20s. ton.
Breeze value—(0 – ⅝ in.) = 5s. ton.
Percentage breeze made per ton coke = 10%.
Value of coke *plus* breeze per ton as made = 18s. 6d.
Value of crude tar = 2¼d. per gallon.
Value of surplus steam = 20d. per 1,000 lbs.

CAPITAL COST OF PLANT (when working on 12-hour carbonizing cycle and making 515 B.Th.U. gas and allowing for loss of time for scurfing) on Durham coal = £280 per ton per day and S. Yorkshire screened coal = £290 per ton per day.

CAPITAL CHARGES allowing for interest, sinking fund, and maintenance = 12% per annum.

Working days per annum = 250.
Labour rated at 11s. 6d. per shift.
Number of men = 12.

TABLE 7.—*Intermittent Vertical Chambers.*

South Yorkshire Screened Coals.

Scheme No.	V	W	X	Y	Z
Calorific Value, B.Th.U.	550	520	500	475	450
Therms per ton	73	78	82	87·5	94
Dry fuel, % on weight of coal	12·25	13·25	14·5	16·3	18·5
Tar, galls. per ton	10	10	10	10	10
Gross coke made, with 5% H_2O (% on weight of coal).	71	70	69	67·65	66·0
Comparative throughput per chamber per day (500 B.Th.U. gas = 100)	118	109·5	100	89·0	78·5
	Pence per Therm.				
Cost of production—					
Coal	3·616	3·385	3·220	3·017	2·809
Labour	0·110	0·110	0·110	0·110	0·110
Fuel	0·393	0·397	0·413	0·435	0·459
Capital	0·412	0·418	0·435	0·457	0·484
Total	4·531	4·310	4·178	4·019	3·862
Less—					
Gross coke	2·160	1·992	1·868	1·717	1·559
Tar	0·343	0·321	0·305	0·286	0·266
Surplus steam	0·104	0·088	0·076	0·058	0·040
Total credit	2·607	2·401	2·249	2·061	1·865
NET COST PER THERM	1·924	1·909	1·929	1·958	1·997

TABLE 8.—*Steam Balance. Intermittent Vertical Chambers.*

Variation in Calorific Value.

Coal	South Yorkshire Screened.					Durham.
Scheme No.	V	W	X	Y	Z	X_1
Calorific Value, B.Th.U.	550	520	500	475	450	500
Therms per ton	73	78	82	87·5	94	82
Dry fuel, % on weight of coal	12·25	13·25	14·5	16·3	18·5	14·0
Lbs. fuel, per therm gas	3·76	3·805	3·96	4·17	4·40	3·83
Gross steam made per therm (after deduction for fan and boiler feed pump)	8·08	8·18	8·51	8·96	9·46	8·22
Steam for steaming chambers, lbs. per therm	1·00	1·88	2·73	3·96	5·26	2·73
Steam for producers, lbs. per therm	1·88	1·90	1·98	2·08	2·20	1·91
Net surplus steam, lbs. per therm	5·20	4·40	3·80	2·92	2·00	3·58
Value of surplus steam at 20d. per 1,000 lbs.	0·104	0·088	0·076	0·058	0·040	0·071

TABLE 9.—*Comparative Costs of Production.*

Continuous Vertical Retorts and Intermittent Vertical Chambers on Yorkshire Screened and Durham Run-of-Mine Coals.

All Figures for 500 B.Th.U. Gas.

—	Continuous Vertical Retorts.		Intermittent Vertical Chambers.	
Coal	S. Yorks. Screened.	Durham. R. of M.	S. Yorks. Screened.	Durham. R. of M.
Therms per ton	80	78	82	82
Dry fuel, % on weight of coal	13·75	15·2	14·5	14·0
Tar, galls. per ton	12·0	11·0	10·0	10·0
Gross coke made, with 5% H_2O (% on weight of coal)	69·0	70·0	69·0	70·0
Comparative throughput, %	100	88	100	103·5
Capital cost—	£	£	£	£
Per ton coal per day	260	295	308	298
Per therm gas per day	3·25	3·78	3·76	3·63
	Pence per Therm.			
Cost of gas production—				
Coal cost	3·300	3·385	3·220	3·220
Labour	0·129	0·146	0·110	0·110
Fuel	0·395	0·449	0·413	0·400
Capital charges	0·374	0·424	0·435	0·420
Total	4·198	4·404	4·178	4·150
Less—				
Gross coke	1·889	1·965	1·868	1·895
Tar	0·375	0·353	0·305	0·305
Surplus steam	0·246	0·289	0·076	0·071
Total credit	2·510	2·607	2·249	2·271
NET COST OF GAS PRODUCTION	1·688	1·797	1·929	1·879

Discussion.

The PRESIDENT, in opening the discussion, said that they had had a most valuable contribution to their proceedings. Whether they accepted all the facts and figures given by Mr. Richards remained to be seen, for they would not all draw the same conclusions.

Mr. JOHN TERRACE (London) said: The useful tables of figures showing the influence of different factors on the carbonizing results in vertical retorts, compiled with the experience of the author, and using assumed figures which apply throughout, will be welcomed by all gas engineers.

Apart from the useful commentary on continuous vertical retorts, intermittent vertical chambers, economics of breeze burning, and the significance of benzole recovery, the figures given and the method of including capital charges along with the coal, labour, and fuel cost, enables one to see the final costs in their proper perspective. It is on the desirability of this perspective view, appealed for by the author at the beginning of his paper, that I want to make a few remarks this afternoon. When about a year ago the articles on "Water Gas as a Coal Gas Auxiliary" appeared in the "GAS JOURNAL" I was so impressed by the way in which costs may be modified by altering the view point that I appealed through the Press for consideration and criticism of the views put forward, as I was afraid owing to publication during the holiday season that the articles might be overlooked by some. The fact that criticisms have not appeared in the Press does not of course mean that they have not been made, nor does the absence of criticism necessarily mean that the views put forward have not received the careful consideration they merited.

My first impulse on perusing Mr. Richards' paper was to join issue with him on the alterations he suggested as being necessary, but, as I learn that a representative of Messrs. Humphreys & Glasgow is present, I am satisfied to leave the contentious points as to the authenticity of some of the figures used and the allocations of the various charges, in his capable hands and confine my attention to the method of presenting the problem of the value of considering such matters in proper perspective. There is one point, however, on which my opinion as the result of experience may be of some value, and that is in connection with "plant capacity." I should consider it quite reasonable to provide 20 millions per day capacity plant in the problem under review.

The consideration of carburetted water gas as a coal gas auxiliary has been brought right up to date in the articles mentioned, and they show very strikingly how misleading it may be to consider the value of water gas production only by its cost per therm into holder. Capital costs are viewed in proper relationship to the use being made of the plant as are also wear and tear charges in arriving at the cost into holder of the coal gas and water gas. By preparing in advance a plan, which the authors describe as "operating strategy," surprising economies are shown to be effected, and the scheme is worthy of the most careful consideration. It may be argued, of course, that most undertakings have to bear charges on a certain amount of less economical plant and other charges for wear and tear that are not taken into account; but although these might cloud the issues, the main point is that it is only by consideration of manufacturing costs in some such manner as that put forward that one can get a proper perspective view of these costs. Having done so the working of the various types of plant in gas-works, whether verticals, horizontals, and/or water gas can be arranged in the most economical manner.

The Water Gas Viewpoint.

Mr. H. S. CHEETHAM (Humphreys & Glasgow, Ltd.) said: Mr. Richards premises his whole argument on the assumption that, in our little treatise, Carburetted Water Gas as a Coal Gas Auxiliary, "the best possible case would be made out for water-gas." He, therefore, makes the best possible case in opposition, saying:

> Between these two differing viewpoints our friends in the Gas Industry may safely be trusted to determine the *via media*.

But, so far as H. & G. are concerned, his over-riding premise is utterly wrong. Our own efforts throughout have been to produce a much-needed technical treatise of trustworthy value to the Gas Industry. To this end, we have ourselves followed the *via media*; we have endeavoured everywhere to use figures sufficiently conservative to withstand any criticism and win the general approval of those impartially skilled in the art. The correct case for carburetted water gas as a coal gas auxiliary is so overwhelming that there is no temptation to exaggerate it. We have simply presented the complete case in accurate form for convenient assimilation.

Although Mr. Richards argues as if we had created our conclusions "out of the blue," these conclusions flow arithmetically from actual costs thoroughly demonstrated in the regular operations of many representative gas-works in this country.

It is now just 35 years since Mr. Glasgow presented his original paper on carburetted water gas as a coal gas auxiliary to the American Gas Light Association. In the then state of the art, the conclusion was that carburetted water gas could be profitably made, to the extent of one-third of the maximum daily production, at a "manufacturing" cost more than double that of coal gas singly. This conclusion was not disputed. On the contrary, the paper was awarded the Association's Gold Medal by a Committee of Past-Presidents, all of whom had supplied coal gas exclusively.

Messrs. Humphreys & Glasgow's far more searching analysis of this problem, under the conditions now prevailing in Great Britain, leads to their conclusion (1):

> Including capital charges, peak load carburetted water gas, as described herein, costs . . . three-fifths the cost of equivalent peak load coal gas.

It would seem, therefore, that the great advance in the manufacture of both carburetted water gas and coal gas during the past 35 years has not materially altered the advantages of carburetted water gas as a coal gas auxiliary.

H. & G.'s treatise, by special invitation, was the subject for discussion last November by the Commercial Section of the Manchester District Association. There were many questions and explanations, but no dispute regarding the conclusions.

Mr. Richards, however, not only denies *in toto* the accuracy of our treatise, but substitutes figures which wipe out practically *all* financial benefit of auxiliary carburetted water gas—see his "Summary of (H. & G.'s) Original and (Richards') Revised Figures." We might, therefore, rest our defence on the

present use of auxiliary carburetted water gas in nearly every gas-works large enough for both processes, and claim *reductio ad absurdum* in respect of such criticism; but we feel that any criticism whatsoever by Mr. Richards merits the fullest consideration from us.

Mr. Richards raises the following issues:

Part I. of H. & G.'s Treatise.

(*a*) *Reserve Capacity.*—In our treatise, the total capacity of the gas-works under consideration includes a margin of 11% over the normal anticipated output of the maximum day. Mr. Richards cancels this margin as "unnecessary," and would limit the maximum capacity to the normal maximum output anticipated. His reason for having no reserve capacity is that any reserve plant benefits the case for auxiliary carburetted water gas, owing to the greater cost of coal gas-works.

We suggest that Mr. Richards is confusing hind-sight with fore-sight. In the chart of the past winter's output, any surplus capacity over the actual maximum required might be said to have proved "unnecessary;" but who can previously guarantee the exact maximum output in the coming winter? We do not believe that any prudent gas manager would be satisfied with less than 11% as a margin to cover unexpected demands.

(*b*) *Capital Costs.*—For our analysis it was necessary to establish the representative cost, per unit of capacity, of coal gas-works and of auxiliary carburetted water gas plant installed therein. The most definite figures available for the actual cost, excluding holders, of a complete modern coal gas-works were those given by Mr. Caton ("GAS JOURNAL," June 12, 1929) for the cost of his new Oxford Works of 2 millions daily capacity—namely, £51,000 per million. In its discussion, this figure was considered cheap.

Alwyne Meade, in his (just published) "The New Modern Gas-Works Practice," gives £60,000 per million as the complete cost, excluding holders but including foreman's house, of a coal gas-works of 2 millions daily capacity; and he suggests that this cost "will probably be considered on the low side."

Throughout our treatise we have adopted £45,000 per million for the *complete cost*, excluding holders, of coal gas-works. Mr. Richards, however, substitutes for our £45,000 the figure of £35,000 (it is really £36,580) taken from the Presidential Address to the Southern Association in 1927 of Mr. Thomas Hardie. No one would dispute any of Mr. Hardie's figures; but he himself makes it quite clear that this figure represents the costs of reconstruction in existing gas-works already fully developed as going concerns—a different matter from a complete new works or section bearing its *pro rata* share of the entire development. While his unique series of reconstruction is a monument to Mr. Hardie's engineering and administrative abilities, his reconstruction costs are not directly applicable to the problem before us.

Nevertheless, we have endeavoured to check our complete estimate of £45,000 against Mr. Hardie's actual reconstruction result of £36,580, by substituting his detailed items and costs for the similar items and their costs in Caton's more complete list of expenditures. This gives a total figure of £48,971. On the whole, our £45,000 remains sufficiently conservative.

(*c*) *Capital Charges.*—In addition to the above great cut in capital price from £45,000 to £35,000, Mr. Richards further alters our capital charges in the following ways:

1. As we have already discussed in (*a*), he eliminates all reserve, and limits the total productive capacity to the anticipated normal maximum output. We leave this question to the judgment of any prudent gas manager.
2. Mr. Richards introduces, under "*Wear and Tear: Peak-Load Coal Gas,*" some strange alterations in our division of plant capacity between base load and peak load, which greatly alter relative capital charges, as well as relative wear and tear. Owing to the fact that one-fifth (or over 3,500,000) of *his* total 18 millions carbonizing plant needs to be let down for six months each summer for repairs, he adds this 3½ millions to our base-load capacity of 10½ millions, and uses this magnified base-load plant of 14,000,000 to increase base-load wear and tear and reduce coal gas peak-load wear and tear correspondingly.

He even applies his magnified capacity to the whole of the base-load works, although, except for present purposes, he would scarcely claim that one-fifth of other than carbonizing plant must be shut down for repairs six months annually.

Incidentally, if Mr. Richards had used the accurate figure of 3,600,000 c.ft. instead of 3,500,000 c.ft. for his one-fifth, he would have proved the impossible, namely, that there is no difference between coal gas peak-load and coal gas base-load wear and tear—4d. in each case. Veritable *reductio ad absurdum!*

Under his next heading, "Capital Charges," he allocates 11½ millions against base load, not only for the carbonizing portion, but again for the rest of the coal gas-works.

There is no justification, in either instance, for increasing whether by 3½ millions or by one million, our 10½ million maximum base-load capacity. A mere glance at our chart shows that we have provided for normally closing down every year, for fully six months, over one-fifth of the (maximum) 10½ million base-load carbonizing plant. Furthermore, in case of need, the reduced summer percentage of carburetted water gas may be increased to any desired extent, and correspondingly displace more (summer) coal gas.

There is no reason whatever for overlapping carburetted water gas and coal gas capacity to create the wholly unnecessary duplication proposed by Mr. Richards.

(*d*) *Wear and Tear.*—Here again Mr. Richards seems to think we have arbitrarily assumed the figure 1·5d. per 1,000 c.ft. for wear and tear of auxiliary carburetted water gas plant. But this 1·5d. is based on the average results, now being regularly obtained, in representative British gas-works which have been making auxiliary carburetted water gas for a generation or more. This ample figure for Great Britain is fully substantiated by still more extensive American experience.

Mr. Richards, on the contrary, deduces a theoretical figure, based on a wrong theory. He assumes that the only difference in repairs, between a complete coal gas-works and auxiliary carburetted water gas plant efficiently installed therein, is confined to the respective carbonizing and generating plants. This difference he takes to be 1½d. per 1,000. He then allots 2d. per 1,000 *equally* to carburetted water gas, for maintenance of the remaining carburetted water gas apparatus, and to coal gas, for maintenance of all the rest of the coal gas-works. We are somewhat amazed at his equalization, because the mere external view of any modern coal gas-works and its miniature-like auxiliary carburetted water gas plant will show the error of this assumption. One critical inspection will explain and justify the actual figure, now being generally realized, which we have used for auxiliary carburetted water gas wear and tear.*

(*e*) *Price of Gas-Oil.*—Regarding Mr. Richards' reference to oil, this is how we arrived at our representative price of 4d. per gallon:

	d.
Price *ex* tank steamer	2
Average inland transportation . . .	0½
New duty	1
Margin	0½
Total	4d.

It is quite possible that economic wisdom will lead the Government to exempt, from the new duty, oil which is used exclusively for the manufacture of gas for general distribution directly to ten million consumers in Great Britain, and indirectly to almost the entire population. On the other hand, the price of coal, in the long run, must follow the base price of coke—or *vice versa*.

The complicated problem under consideration has so many angles, and our treatise is so condensed, that Mr. Richards' criticisms may easily be based on misapprehensions. We cordially hope that our present explanations will convince him and his able colleagues, as well as any patient gas manager who can make the time and will take the trouble to verify our solution, that all of our original figures are substantially correct. These elaborate criticisms of our Part I. serve only to confirm the accuracy of our analysis and the soundness of our conclusions.

Part II. of H. & G.'s Treatise.

Mr. Richards thinks that we have greatly exaggerated the probable reflex effect of auxiliary carburetted water gas on gas coke and tar prices. We, in our turn, may quote Mr. Thomas Hardie ("GAS JOURNAL," Dec. 11, 1929):

> If all the gas manufactured last year for town purposes had been coal gas, there would have been 11 million tons of coke and breeze for disposal; but, due to the manufacture of water gas, the actual quantity for disposal was only 7,700,000 tons.
>
> It is not difficult to forecast what would have happened if this extra quantity of coke had been placed on the market. The coke market would have slumped enormously, and the price of gas would have had to be increased greatly in order to balance the reduced revenue from coke. From this point of view it was difficult to estimate how great was the value of water gas plants.

Mr. Richards does not perhaps fully realize how quickly slight cumulative over-production of any local commodity will collapse its price; nor how much the additional expenses of crushing, sorting, conditioning, and petty marketing reduce gas coke profits; nor the extent to which additional sales of coke for domestic purposes, achieved through such additional expenses, may deprive gas of its most logical and profitable field of usefulness; nor that the receipts from gas sales and rentals are seven or eight times the receipts from coke and breeze, even when auxiliary carburetted water gas is charged with coke at the higher prices which it creates; nor that gas coke is a bye-product whose production cannot be independently regulated or adjusted to profitable demand—witness the low prices at which British gas coke is dumped abroad, indirectly helping foreign trade in competition with other British exports.

There is danger in losing true perspective and becoming "coke-minded" at the expense of gas. Gas *qua* gas is a monopoly; there is no gaseous competitor. We have only to show that gas is the best fuel, which is easy, and to sell it sufficiently cheaply—and we supply it all. But gas coke is in competition with oven coke, with gas coke from other sources, and with all other solid fuels, not to speak of liquid fuels—and gas!

On the other hand, it is generally agreed that auxiliary car-

* Mr. Richards uses the figures for carburetted water gas *per se*, instead of for auxiliary carburetted water gas. The *per se* C.W.G. figures are deduced from auxiliary carburetted water gas operation, and are presented merely as of possible interest; they do not enter into the argument. On the other hand, the auxiliary C W.G. figures in H. & G.'s treatise represent actual working results on which the whole analysis and conclusions are based.

buretted water gas affords the one perfect means of adjusting the production of gas coke to the most profitable demand, while maintaining the high quality of gas which minimizes the expenses of distribution and utilization. Why not make gas coke into gas, instead of substituting gas coke for gas?

Part III. of H. & G.'s Treatise.

Here, in a nutshell, is the final and positive "proof of the pudding." Mr. Richards does not, and no one will, dispute this wide and long practical experience of auxiliary carburetted water gas by such important gas undertakings.

May we now end this lengthy discussion on a more personal note? We regret this controversy. We wish we might have reconciled our views, by previous discussion, before Mr. Richards was committed to this portion of his paper. We have, and have always had, the highest admiration for W-D's personnel and for their brilliant contributions to the progress and dignity of the Gas Industry. We had hoped that they viewed our own efforts in the same light. Both of us are doing all in our power to further the prosperity of the Industry on which we both depend. Consequently, each of us should eventually profit by the progress of the other. We heartily wish them even greater success—with no further differences between us.

Comparative Figures from Croydon.

Mr. W. Grogono (Croydon), in congratulating Mr. Richards on his paper, remarked that when anybody mentioned the subject of costing the Croydon Company immediately became very interested, as they rather prided themselves on their methods of costing. They must not lose sight of the fact that different types of plant were installed in different works due to practical reasons and not always because the capital costs or working costs were necessarily less. Mr. Richards had given wear and tear figures for coal gas and water gas; the corresponding figures at Croydon were 3·880d. with coal gas and 2·443d. with carburetted water gas, and the total worked out in proportion to 3·587d. for both. But it must be borne in mind that besides the coal gas and water gas plant there was a great deal of ancillary plant, such as locomotives, &c., and the wear and tear on the ancillary plant was allotted proportionately to the gas made. The purifiers, of course, were attached to their own coal or water gas plant and could therefore be allotted directly.

In regard to Mr. Richards' reference to coke and coke appliances, Mr. Grogono observed that there was a London and Counties Coke Association, who had a Technical Committee—and that Technical Committee was the most live committee on which he had ever had the honour to serve. It was doing a tremendous amount of work in the actual designing of appliances, besides looking after grading and handling of coke. He referred to a block of flats in Putney where coke was being used for hot water supply. The plant was originally designed for oil, but the oil had never been used at all, and coke was being used instead as a result of the efforts of the Wandsworth and District Gas Company.

Mr. Grogono went on to give the figures for the intermittent vertical chamber plant at Croydon which compared with those given by Mr. Richards in Table 7 as follows:

Calorific value, B Th.U.	549
Therms per ton	78·62
Dry fuel, % on weight of coal	13·05
Tar, galls. per ton	13·35
Gross coke made, with 5% H_2O (% on weight of coal)	69·50
	d. per Therm.
Cost of production—	
Coal	3·740
Labour	0·158
Fuel	0·362
Capital	0·443
Total	4·703
Less—	
Gross coke	2·334
Tar	0·425
Surplus steam	0·050
Total credit	2·809
Net cost per therm	1·894

These figures were remarkably close to those given by Mr. Richards. At Croydon they charged themselves the lowest contract price for coke used on the works.

A Detached View.

Mr. W. W. Townsend (Colchester) said that he admired Mr. Richards' detached view of the matter, and if they read the paper carefully they would realize that the question of quality was considered but not directly mentioned. This had a great bearing on the whole matter. It was not sufficient to compare cost of gas per therm as such, which one would think was the same everywhere. It was not the same everywhere. Mr. Richards had referred to "fat therms and lean therms;" but there were other sorts of therms as well, such as dirty therms and clean therms. They must decide what products they wanted to make, which must be the products the buyers required. It was high time they had a specification for gas; they had them for other materials which were less important. If they had a specification, then all gas with an inert content exceeding a certain figure would be ruled out straight away. This had a bearing on the question of carburetted water gas *versus* coal gas. It was no use proving by columns of figures that it was cheaper to produce water gas for peak loads. Nobody would be so unwise as to try to do it. He was himself a believer in water gas, but he used a constant percentage all the year round, and he did not believe in meeting a sudden increased demand by piling on the water gas plant. It upset various fundamentals, particularly the specific gravity of the gas. They should go further and consider the quality of the coke they were going to make, as well as the amount of tar and benzole produced. The best market for coke at the present time was for the closed stove for hot water supply and central heating, while the best market for tar was for road making purposes, and for benzole, motor spirit; and they should set out to meet the demands for these three products. He would endorse what Mr. Grogono had said in regard to the London and Counties Coke Association, which, he believed, was the largest single body dealing with solid fuel in this country—and it had been doing it successfully for three years. All the things suggested by Mr. Richards had been or were being dealt with by that body.

Mr. J. T. Haynes (Rotherham) congratulated Mr. Richards on a very instructive and—he thought he might say—provocative paper. As a Lancashire man by birth and a Yorkshire man by adoption, he sometimes rushed in where angels feared to tread. He wished to draw attention to the reference to carburetted water gas. Mr. Grogono had mentioned the fact that coke had superseded oil in a block of flats; the Gas Industry was endeavouring to introduce coke equipment in many instances instead of foreign oil. But if the Industry was in competition with foreign oil it should be left out of their water gas production. Mr. Haynes regretted that Mr. Richards had not been in a position to make similar comparisons in regard to horizontal retorts and coke ovens as he had done with continuous verticals and intermittent chamber ovens. But taking the two types he had referred to, Mr. Haynes suggested that he was rather wrong in the premises he had made regarding the fuel used by the two plants, because he thought he was right in saying that the inclined chamber, the horizontal retort, and the coke oven could utilize a type of fuel considerably cheaper than the high-grade fuel necessary for vertical retorts. From a recent paper by Mr. James Carr, of Stretford [see "Gas Journal" for Oct. 17, p. 216], before the Manchester and District Junior Association, he was quite satisfied that a type of coal could be used considerably cheaper than for vertical retorts, and his own rough calculations indicated that the cost of making 500 B.Th.U. gas in intermittent vertical chambers, given by Mr. Richards as 1·929d. per them, should be nearer 1·2d. per therm for the reduced cost of coal, even if the same value for coke was taken into account. So it seemed to him that on Mr. Richards' own figures, making allowance for the value of the coke, intermittent chambers were better than vertical retorts. Then Mr. Richards seemed to prove conclusively that gas could be produced more advantageously at a calorific value of 500 B.Th.U. in both types of plant. Those of them who had experience of coke ovens and horizontals knew that 500 B.Th.U. gas seemed to meet the case there.

In regard to Mr. Richards' remark that for an existing set of conditions with continuous vertical retorts, the best return from benzole washing followed a reduction in declared calorific value of gas rather than a rise in the calorific value of the unstripped gas, it seemed to Mr. Haynes that they could carry that on *ad infinitum*. Instead of washing for benzole they were reducing the quality of the gas until they reached the stage of their friend who turned out 200 B.Th.U. gas.

Mr. F. H. Robinson (Bishop's Stortford) also described the paper as very valuable. It ably showed, he said, the necessity of making up complete balance-sheets when considering any alteration in working or the installation of new plant. An alteration in one factor in carbonization could affect many items, and it was not possible to tell the full effect until all circumstances had been taken into account; otherwise misleading results were obtained. As Mr. Richards said, the whole must be viewed in proper perspective. The extraction of benzole was a case in point, particularly where there was an installation of vertical retorts and water gas.

Say the calorific value of the gas was fixed at 500 B.Th.U. per c.ft. To enable one to extract benzole from the mixed gas, the working had to be altered in both plants. A richer initial gas had to be made to permit of the standard calorific value being maintained after washing. If, for example, two gallons of benzole per ton were to be extracted, steaming would have to be considerably cut down in the verticals and a gas of 525 B.Th.U. produced before washing to permit of the final gas being 505 B.Th.U. This meant a reduced thermal yield per ton in the retort house, in addition to the reduction due to oil washing. More coal was therefore used, more labour required, more coke and tar for sale, and more repairs, due to a greater weight of material being handled. More oil was also used in the water gas plant. From their experience at Bishop's Stortford when producing two gallons per ton from continuous verti-

cal retorts, the total reduction in thermal yield was from 78 therms to 70·8 therms per ton, approximately 10%.

The following figures were prepared some three months ago, based on their working, and they supported Mr. Richards' statements.

—	No Washing.	2 Galls. per Ton
C.V. before washing	505	525
Thermal yield before washing	78 therms	74 therms
C.V. after washing	,,	505
Thermal yield after washing	,,	70·8 therms
Oil used per 1,000 c.ft. in C.W.G. plant	2·1 galls.	2·5 galls.

The extra cost of carbonizing, after allowing for increased production of coke and tar, worked out at £253 a year. Adding interest and depreciation of the benzole plant and cost of working (£165 a year), the total cost was £418 a year—equivalent to 5·92d. per gallon. Adding extra carbonizing wages, purification, and repairs, in respect of the increased quantity of materials dealt with, the final cost was 8·86d. per gallon of benzole produced, leaving a clear margin of a little over ½d. per gallon. If similar calculations were made for yields of 1 gallon and 1½ gallons per ton, it was found that there was a definite loss at 1 gallon per ton, while at 1½ gallons per ton the process just paid for itself. This was under their conditions with 20% of water gas. It might be argued that if surplus carbonizing plant was available and stokers could take on extra retorts without extra pay, there should be no charge for carbonizing wages. On the other hand, it might be that the extra coal carbonized would necessitate extra labour on a larger plant. The cost should therefore be included if the perspective was to be obtained. In all such calculations, the gas output should be the basis and not the coal carbonized. The above calculations were based on an annual output of 750,000 therms a year, the output from their Bishop's Stortford Works. At their Epping Works they had horizontal retorts, but figures were not yet available from the benzole plant there, as it had only recently been put to work.

Turning to the question of carburetted water gas as an auxiliary to coal gas, three years ago when in Yorkshire Mr. Robinson made some calculations based on their conditions there as to costs of labour, coal, coke, &c., with a gas of 460 B.Th.U. and an output of 2 million c.ft. per day.

Coal gas with steaming in continuous vertical retorts cost 2·23d. per therm.

Blue water gas for dilution, would cost 2·06d. per therm in a separate plant of 1 million c.ft. a day capacity.

To produce 460 gas from the two separate plants by mixing would necessitate coal gas being made of 540 B.Th.U quality but cutting off steam, to mix with blue water gas at 300 B.Th.U. in the proportions of two parts coal gas and one part of blue gas.

The resulting mixture would then cost 2·16d. per therm *plus* the interest and depreciation of plant, but omitting overlookers, exhaustermen, boilermen, and other items common to both systems. Carburetted water gas of 460 B.Th.U. would have cost 2·82d. per therm at the prices ruling at that time. A mixture of equal quantities of coal gas and C.W.C. would have cost 2·52d. a therm. Carrying the calculations a stage further and proportioning the make of coal gas and C.W.G. so as to gasify all coal and coke, having only tar and gas for sale, the cost worked out at 2·63d. a therm. These results were based on 21s. 4d. a ton for coal, 22s. a ton for coke, and 4d. a gallon for oil, with a resultant gas of 460 B.Th.U.

Another engineer in Yorkshire at that time gave him some figures showing that, with horizontal retorts, coal gas of 556 B.Th.U. cost 2·4d. per therm for coal and labour less residuals, and C.W.G. of 324 B.Th.U. cost 2·31d. per therm for oil, coke, and labour, less tar. When the conditions and prices of his own works were substituted for his conditions and prices, C.W.G. became the dearer, coal gas being 2·02d. a therm and C.W.G. 2·11d. a therm. In conclusion, Mr. Robinson said he had ventured to put these figures forward because, although prepared some time ago, they supported Mr. Richards' contention that to arrive at a true perspective of carbonizing every factor must be taken into account and a complete balance-sheet made.

Mr. C. E. Byrt (Gainsborough) remarked that as an engineer who had recently installed vertical retorts this paper would be of great benefit to him. The matter of breeze was rather a bugbear to him, and he thought that the figures given in this respect by Mr. Richards were somewhat contradictory. He used to produce a very small proportion of breeze, but now it was a rather large proportion. It might be due to the fact that he was not carbonizing a very good coking coal. Mr. Richards had stated that if they burnt breeze they were burning fuel at 5s. per ton. But the breeze was made from the coke, and if one's plant was producing a high percentage of breeze they were literally burning their coke.

Mr. P. D. Walmsley (Great Yarmouth), referring to Mr. Robinson's figures for benzole recovery at Bishop's Stortford, said they would all be inclined to agree that benzole extraction was not profitable unless they were obtaining 2 gallons per ton of coal carbonized.

Vote of Thanks.

Mr. Grogono, in proposing a vote of thanks to Mr. Richards for his paper, said that they had all thoroughly enjoyed the discussion. It seemed to him that this paper had achieved one very great thing—it had brought them a step nearer standardization of costing, for which the whole Industry was crying out—a method of costing which would include every man working in a gas-works.

Mr. Townsend, seconding the vote of thanks, said that one could not get "perspective" unless one used two eyes. There was a time when everyone made a fetish of make per ton and then therms per ton. But Mr. Richards had pointed out that the taking of every item into consideration could not be done too frequently; they must take into account the value of the products they made as well as the quantities. Their Association was honoured in having a gentleman of Mr. Richards' eminence to present a paper.

Written Reply by Mr. Richards to the Discussion

Mr. F. B. Richards (in a written reply to the discussion) says: My paper was intentionally provocative in the hope of giving rise to a lively discussion which always seems to me to be the most valuable function of the presentation of a paper. I am very grateful to the many members of the Association who have taken part in the discussion. To a considerable extent this has taken the form more of comment than query, and there is not a great deal to which I have to reply.

I was glad to find that Mr. Terrace, Mr. Grogono, and Mr. Robinson each supported what was intended to be the crux of the paper—namely, the need for preparing a complete balance-sheet before assessing the importance of a change in gas production methods.

Mr. Terrace made the point that he would consider it quite reasonable to provide 20 millions per day capacity plant in the problem under review. My reason for suggesting 18 millions nominal capacity is that coal gas plant is generally rated at a figure making allowance for scurfing, &c., and can when required meet a day's demand well in excess of its nominal capacity.

Mr. Haynes suggests that cheaper coal can be used in intermittent types of carbonizing plant than in continuous. He may be interested to know that continuous vertical retorts can now handle successfully slack coals such as are often used in coke ovens in the neighbourhood of Rotherham. On the other hand, the view has frequently been expressed that it does not pay gas undertakings remote from the coal fields to buy any but the best coals.

I listened with much interest to the criticism presented by Mr. Cheetham on behalf of Messrs. Humphreys & Glasgow in reply to the section of my paper on carburetted water gas as a coal gas auxiliary. I do not propose to traverse again the technical arguments, being quite prepared, as stated in my paper, to leave "our friends in the Gas Industry to determine the *via media*." There are, however, one or two general remarks which I may perhaps be permitted to add in reply to Mr. Cheetham's contribution.

First, it is necessary to point out that my remarks were not intended as an attack on water gas, but as a defence of coal gas. Nothing was further from my mind than to question Messrs. Humphreys & Glasgow's knowledge or accuracy relating to carburetted water gas production; but when it comes to calculations on coal gas manufacture one may claim, with all modesty, at least as great a knowledge as the authors of the treatise on carburetted water gas.

Secondly, it may fairly be said that the price of a works having a capacity of 2 million c.ft. per day is scarcely a safe guide for determining the capital cost of an 18 or 20 million works. As regards the figure of £35,000 per million, I can assure Messrs. Humphreys & Glasgow that if they could encourage a gas undertaking to lay out an entirely new 18 million c.ft. per day coal-gas works on a brand new site, I can arrange to put forward an entirely satisfactory project, complete in every detail, for £630,000!

Eastern Counties Gas Managers' Association

HALF-YEARLY MEETING IN LONDON

The Autumn Meeting of the Eastern Counties Gas Managers' Association was held at 28, Grosvenor Gardens, S.W. 1, on Thursday, Oct. 25, 1934—the PRESIDENT (Mr. F. G. Brockway, of Cleethorpes) in the chair.

The Minutes of the previous meeting, as published in the Technical Press, were taken as read and were duly confirmed and signed.

The PRESIDENT extended a welcome to all their visitors; and went on to refer feelingly to the passing of an old and esteemed member of the Association—namely, Mr. J. W. Auchterlonie, of Cambridge. Mr. Auchterlonie, he said, was a Past-President of their Association and a member since 1903. The Secretary of the Association and himself, together with a number of other members, attended the funeral service. Mr. Auchterlonie was one of their most valued members, and they would never forget his genial personality and his wise counsel. Those present stood for a moment as a mark of respect.

The HON. SECRETARY AND TREASURER (Mr. W. C. Chapman, of Boston) read a letter from the Institution of Gas Engineers urging members of the Association to become members of the Association of Public Lighting Engineers and the Illuminating Engineering Society. He also read apologies for absence from, among others, Mr. C. Valon Bennett (President of the Institution of Gas Engineers), Mr. Stephen Lacey (Vice-President of the Institution of Gas Engineers), Lieut.-Col. H. K. Stephenson (President of the B.C.G.A.), Mr. W. E. Price (Hon. Secretary of the Institution of Gas Engineers), Mr. G. Dixon (Nottingham), Mr. R. S. Ramsden (President of the Midland Association), Mr. D. W. Turner (Chairman of Council, S.B.G.I.), Mr. J. C. Walker (General Secretary, B.C.G.A.), and from members of the Association.

New Members.

The following were then elected to the Association on the proposition of Mr. C. FOWLER (Leiston), seconded by Mr. B. CLARK (Stamford):

To Membership.—S. G. Callingham (Woodhall Spa); R. E. Wiles (Heckington).

To Associate Membership.—G. E. Goldspink (Nottingham); H. S. Cheetham (Esher).

Presentation of Certificates.

The PRESIDENT announced the presentation of certificates to the following:

R. S. Cureton (Boston), Internal 2nd Class Higher Grade Gas Engineering; E. J. Fillery (Newark), External 1st Class Higher Grade Gas Engineering; J. A. Day (Hitchin), External 2nd Class Higher Grade Gas Engineering.

Mr. F. B. RICHARDS then presented his paper on "Perspective in Carbonizing Costs."

Elections.

Mr. G. WRIGHT (Lincoln) proposed, and Mr. P. WALMSLEY (Great Yarmouth) seconded, that Mr. Brockway be appointed as the Association's representative on the Council of the Institution of Gas Engineers for the coming year. This was unanimously agreed to, and Mr. Brockway recorded his appreciation of being elected to represent them on the Parent Body.

Mr. BROCKWAY thereafter proposed that Mr. B. Clark be elected as the next President of the Association—an office which they felt sure he would discharge alike with credit to himself and success to the Association.

This was seconded by Mr. C. E. BYRT (Gainsborough) and unanimously carried, Mr. CLARK briefly returning thanks for the compliment and acknowledging his appreciation of their action in electing to the Presidency a younger man and one who represented a small undertaking. He would endeavour to serve them well.

On the proposition of Mr. T. V. JOHNS (Lowestoft), seconded by Mr. F. N. HOWES (Chelmsford), the election of Mr. G. Wright to the office of Vice-President was unanimously agreed to, and the latter briefly acknowledged his appreciation of his election.

It was proposed by Mr. S. HANDS (Sleaford) and seconded by Mr. H. G. RUGGLES (Leighton) that the following be elected to the Council of the Association: Messrs. J. Kennington (Grimsby), J. E. Young (Grantham), and C. E. Byrt (Gainsborough).

The Association's Auditors (Messrs. W. S. Venner and G. A. Mallett) were re-appointed on the proposition of Mr. C. E. GRIMWOOD (Sudbury), seconded by Mr. H. R. WIMHURST (Bury St. Edmunds), reference being made to their valuable services to the Association, and also to the fact that Mr. Mallett was to become the Mayor of Ipswich. It was decided to write a letter on behalf of the Association, wishing him a successful and happy year of office.

On the proposition of the PRESIDENT, seconded by Mr. B. CLARK, the Hon. Secretary and Treasurer (Mr. W. C. Chapman) was unanimously re-elected, tribute being paid to his work for the Association.

In acknowledging his re-election, Mr. CHAPMAN observed how much he appreciated the manner in which they had received the proposition for his re-election and the pleasure they showed for the little efforts he made on behalf of the Association.

Mr. J. H. TROUGHTON (Newmarket) proposed, and Mr. J. GREEN (Wisbech) seconded, the re-election of Mr. E. F. Keable (Gorleston) as the Education Scheme Secretary. This was unanimously carried.

The PRESIDENT announced that there had been no calls on the President's Benevolent Fund during the year and that the funds were in a healthy state.

Mr. B. CLARK extended from the Chairman and Directors of his Company a cordial invitation to the Association to hold their next meeting at Stamford, which the PRESIDENT gratefully accepted on behalf of the members.

In concluding the meeting, Mr. BROCKWAY referred to the pleasure and privilege it had been to him to serve them as President during the past year. This was the last time he would occupy the Presidential Chair, and he wished to say how thoroughly he had enjoyed his year of office. His work had been made easy by the Officers and Council of the Association who had helped him, while he also thanked the members for their support and the excellent attendances at the meetings and for their assistance generally.

Gas Undertakings' Results.

Blackpool.

The gross profit of the County Borough of Blackpool Gas Department for the year ended March 31, 1934, is £38,921, and after deducting loan charges of £22,074, there remains a net profit of £16,847. The balance of the appropriation account at March 31, 1935, was £28,336, out of which has been spent during the year the sum of £14,508, leaving a net amount in this fund of £13,828, which together with the net profit of £16,847 gives a balance of £30,675 at March 31, 1934. Of this amount it is proposed to transfer £4,000 in aid of the rates, £3,000 for special vote, £10,320 for special expenditure, and to carry forward to the next year's accounts the balance of £13,355. At the end of March, 1934, there was a total of 35,366 consumers; 20,844 of these are supplied with ordinary meters, and 14,522 are provided with prepayment meters. During the year 2,528 new consumers have been connected to the supply mains. 922 ordinary meters have been changed to prepayment meters and 159 prepayment meters have been changed to ordinary meters. The average consumption per consumer during the year was 33,811 c.ft. The number of street lamps within the Borough is now 4,673, and in the Marton Area 247, and accounts for 77,027,300 c.ft. of gas. 276 new lamps have been erected during the year in the area of supply. During the year a new gasworks site of approximately 100 acres has been purchased, the Ministry of Health having granted borrowing powers for £68,404 for land, a 30-in. trunk main, and a 3-million c.ft. capacity gasholder. It is anticipated that the new main and gasholder will be completed in March, 1935. The business conducted through the showroom has been satisfactory, and apparatus to the value of £31,023 has been sold.

Leamington.

The Directors' report and statement of accounts for the half-year ended June 30, 1934, shows that the Leamington Priors Gas Company has increased its output by 4½%, and has created a sales record for the year. Each branch of gas sales—ordinary meter, prepayment meter, and public lighting—shows an increase, the receipts amounting to £37,026, compared with £35,718 for the corresponding period last year. Tar and other residuals realized £2,149. There was £15,129 available, applicable to the payment of dividends, being the balance on the profit and loss account. The Directors recommended the payment of the statutory dividends, less income-tax, on Oct. 1. During the year under review, a new coke cutting and screening plant had been erected to meet the demand for broken coke.

Autumn Research Meeting of the Institution

Eleven Reports are to be presented at the 6th Autumn Research Meeting of the Institution of Gas Engineers to be held in London on Nov. 6 and 7. Of these we have already published three, either in full or in abstract form—Standard Specification for Refractory Materials for Gas-Works ("JOURNAL" for Aug. 22, p. 414); Report on the Use of Coal Tar Oils in Internal Combustion Engines, by H. M. Spiers, M.A., B.Sc., F.I.C., and E. W. Smith, C.B.E., D.Sc., F.I.C. ("JOURNAL" for Sept. 19, p. 642); and Notes on the Visit of the Institution of Gas Engineers to Canada and the United States of America, 1933, by F. J. Dent, Ph.D., B.Sc. ("JOURNAL" for Oct. 10, p. 136). To-day we give summaries and abstracts of the remaining Reports, with the exception of the 5th Report of the General Research Committee, 1933-34, which is not yet available.

Institution Gas Research Fellowship Report, 1931-34

The Reactivities to Carbon Dioxide of Cokes and Other Forms of Carbon at High Temperatures

By T. H. BLAKELEY, Ph.D.,
Institution Gas Research Fellow,
AND
JOHN W. COBB, C.B.E., B.Sc., F.I.C.,
Livesey Professor.

In the work described, an attempt has been made to deal with the comparative reactivities of cokes and similar substances which can be conveniently classed as forms of carbon, at the high temperatures attained in such industrial appliances as the gas-producer and the blast furnace. The reactivity to carbon dioxide has accordingly been measured up to 1,500° C. The method used has in its essentials been that previously described by Branson and Cobb[1] for the determination at 900° C. This method allows a succession of values for the reactivity of a coke to be obtained from the extent of reduction of carbon dioxide to carbon monoxide effected at different stages in its gasification under standard conditions. Owing, however, to the very high rates of gasification attained at high temperatures, it was found necessary (1) to dilute the carbon dioxide with nitrogen, and (2) to lessen the time of contact by using a smaller weight of carbon and a more rapid gas stream.

The values obtained for reactivity have been expressed on the Key-Cobb scale,* which has been found convenient, and with suitable adjustments to allow all reactivities, determined as above, to be expressed in terms of the unit reactivity adopted for the scale.

The results indicated, as would be anticipated, that at high temperatures the reactivities were very greatly increased, being, roughly speaking, multiplied a hundred times when the temperature was raised from 900° C. to 1,400° C. The difference between the reactivities of two cokes expressed numerically was also greatly increased. Thus the reactivities of Holmside (Durham) coke and New Hucknall (Notts.) coke, which were 0·30 and 2·04 at 900° C., became 100 and 220 at 1,400° C. In plotting curves, it has been found desirable to use a logarithmic scale for reactivities, as will be understood from a comparison of Figures 1 and 2. It is true that the differences in reactivity increase with temperature, as is shown clearly by Figure 1, but in practice it is the ratio of the reactivities which is important, and this ratio is given by the difference of their logarithms, indicated by the relative positions on the curves of Figure 2, where the reactivities are plotted logarithmically. It has been found that the ratio of the reactivities of the cokes and carbons considered decreases as the temperature rises, but the difference persists at 1,400°-1,500° C., and seems likely to do so at considerably higher temperatures.

One complication in these determinations arises from the fact that the material may alter of itself under the severe heat treatment to which it is sometimes subjected, as the test proceeds. It will, of course, be liable to a similar alteration in practice. Experiments have therefore been made in which the material was subjected to heat treatment for 15 minutes at 1,400° C. before testing, to eliminate or minimize these changes, and they are shown to have an appreciable effect, but not to invalidate the results obtained.

The position is therefore established that the reactivities are enormously increased at high temperatures and that

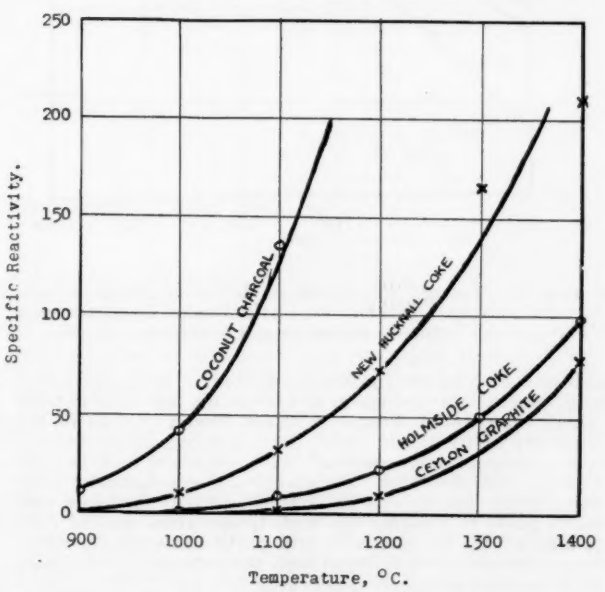


FIGURE 1.—*Specific Reactivity at Different Temperatures of Four Fuels varying widely in Reactivity, shown on a Linear Reactivity Scale.*

differences persist, but there is another consideration of primary importance, and that is whether these persisting differences will have any appreciable effect under the conditions of practice.

The time of contact then becomes of paramount importance, as is illustrated in Figures 3 and 4, in which are plotted the percentage decompositions of carbon dioxide effected by four fuels differing markedly in reactivity (charcoal, two cokes, and graphite), the times of contact being approximately 1/10 second (Figure 3) and one second (Figure 4).

Summarizing, it appears that for these four fuels the effect of the marked differences in reactivity which they

[1] Institution Gas Research Fellowship Report. Trans. Inst. Gas Eng., 1926-27, p. 333.
* J.S.C.I., 1930, **49**, 439.

have been shown to possess, is of practical importance in the reduction of carbon dioxide only when the time of contact between them and the gasifying medium exceeds 1 second at 1,250° C., or 1/10 second at 1,550° C. In the section which follows, entitled "Application of the Results to Practice," this theme is developed. It would seem that the influence of reactivity must remain in many cases, but the assumptions which have to be made, particularly as to time of contact, in making calculations are so far speculative that direct experiment on the working scale would be necessary for final determination of the issue in some cases.

Various observations of interest have been made in the course of this work. It has shown for example that the reactivity of coke prepared from Sharlston Wallsend coal which had been exposed to air after grinding, was almost as high as that of the coke from the moderately coking New Hucknall coal, although coke from the same coal freshly ground resembled in its low reactivity that from the strongly coking Durham Holmside coal. Another interesting observation was that petroleum coke and retort carbon displayed abnormally small increases in specific reactivity with temperature, as compared with the cokes and other forms of carbon examined.

Application of the Results to Practice.

There are admitted difficulties in applying to practice the results of such small-scale experiments as have been described. Many workers have rightly stressed the importance of coke size, pointing out that a decrease in size may increase the reduction of carbon dioxide to a greater extent than would ordinarily result from variation in the reactivity of the coke.[2] But, if the grading of the coke is kept approximately constant, as is common in many industrial and domestic appliances, the comparative reactivity of the fuel has its full effect, and it is therefore well worth while to consider the high temperature uses of coke as affected by its reactivity and particularly by the enormous increase of reactivity at high temperatures with which we have been primarily concerned.

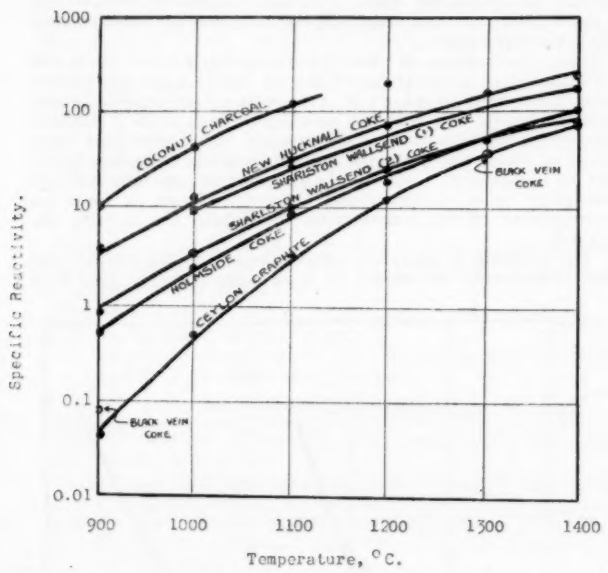


FIGURE 2.—*Specific Reactivity at Different Temperatures of Cokes from Bituminous Coals, Ceylon Graphite, and Coconut Charcoal, shown on a Logarithmic Scale.*

We have shown that differences in the reactivity of cokes from bituminous coals persist to high temperatures (1,400°-1,500° C.), and they will, in the absence of some sudden unexpected change continue to still higher temperatures. Partly as the result of heat treatment, and a decrease in reactivity arising from that cause, the differences between the cokes tend to lessen as the temperature is raised, but a large difference still remains, and its importance in practice will be governed by the time of contact between the coke and the gasifying medium in various applications.

In illustration, the importance of time of contact may be considered in relation to the fuels coconut charcoal, New Hucknall coke, Holmside coke, and Ceylon graphite, which possess very high, moderately high, moderately low, and very low specific reactivity respectively. The variation of their specific reactivities with temperature has already been given (Figure 2). In Figure 3 these results are expressed, not in terms of specific reactivity, but as the percentage decompositions of carbon dioxide which would be obtained if 5 gm. of the fuel were gasified in a 20 per cent. carbon dioxide mixture flowing at 25 l. per hour.

The time of contact between the coke and the gasifying medium would be $\frac{1}{10}$ - $\frac{1}{20}$ second. In form, the curves closely resemble those in which Arend and Wagner[3] expressed the results of their work. At 1,400° C. both coconut charcoal and the New Hucknall coke show complete decomposition of carbon dioxide, and would therefore give the same effect for this, or a greater, time of contact. Differences in reactivity exist but have no significance. On the other hand, Holmside coke and Ceylon graphite give definitely lower percentage decompositions at 1,400° C., and so would differ in behaviour from one another and from the other two fuels, but it appears likely that at

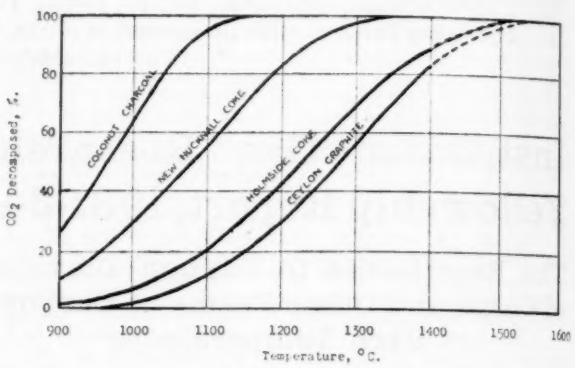


FIGURE 3.—*Percentage Decomposition of Carbon Dioxide in a 20 per cent. CO_2 Mixture (80 per cent. N_2) with a Contact Time of $\frac{1}{10}$-$\frac{1}{20}$ Second.*

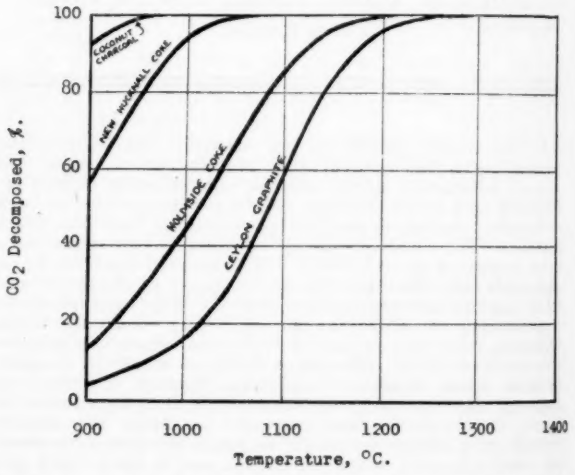


FIGURE 4.—*Calculated Percentage Decomposition of Carbon Dioxide in a 20 per cent. CO_2 Mixture (80 per cent. N_2) with a Contact Time of $\frac{1}{2}$-1 Second.*

1,500°-1,600° C., judging by the trend of the curves in Figure 3, all four fuels would give practically complete decomposition.

Figure 3 may now be compared with Figure 4, in which calculated percentage decompositions of carbon dioxide are given for a time of contact ten times as great as before—*i.e.*, $\frac{1}{2}$-1 second. 100 per cent. decomposition of carbon dioxide is first shown by coconut charcoal at 950° C., by New Hucknall coke at 1,050° C., by Holmside coke at 1,200° C., and by Ceylon graphite at 1,250° C. Thus at 1,300° C. or above, all four fuels will show the same effect, in terms of the gas leaving the coke column—a state not reached for about another 300° when the time of contact is reduced to one-tenth, as seen in Figure 3. To summarize, it appears that for these four fuels the effect of marked differences in reactivity, which have been shown to exist, is negligible if the time of contact between them

[2] See, *inter alia*, Fieldner, Chem. and Met. Eng., 1923, **29**, 1,052; Sherman and Kinney, Fuel, 1926, **5**, 98; Davis and Reynolds, Ind. Eng. Chem., 1928, **20**, 617; Mott and Wheeler, "Coke for Blast Furnaces."

[3] Fuel, 1926, **5**, 106.

and the gasifying medium exceeds 1 second at 1,250° C., or $\frac{1}{10}$ second at 1,550° C., when the coke is graded $\frac{1}{4}$ in.-$\frac{1}{10}$ in.

These conclusions may be considered in relation to the temperatures and contact times prevailing in industrial coke-consuming appliances, in which high temperatures are attained, such as the blast furnace, the foundry cupola, and the producer-gas and water gas generator. In all these, the difficulties of estimating the effective contact time at high temperature are great, partly from uncertainty as to the size of the high-temperature zone, and partly because the percentage of free space in this zone is also uncertain.

The contact time in the hearth of the blast furnace is estimated by Broche and Nedelmann[4] to be about 0·25 sec. This is about 2½ times the contact time of Figure 3, so that it would appear that all cokes, at the temperatures of 1,500° C. and above, existing in the hearth of a blast furnace, are sufficiently reactive to give 100 per cent. conversion to carbon monoxide. This supports the contention that an unreactive coke is best for the blast furnace, the term "unreactive" being applied to the behaviour of the coke under test at 900°-1,000° C. Such a coke would be resistant to "solution" loss (gasification of carbon) during the descent of the shaft, but at the temperature prevailing at the hearth it would be sufficiently reactive to give practically complete formation of carbon monoxide. It would therefore combine low reactivity in the shaft with high reactivity in the hearth, this desirable combination of properties in one coke being attained by the large increase of specific reactivity with temperature.

There seems to be no doubt concerning the reactivity desirable in a coke for use in the foundry cupola. Because this coke is used simply to melt metal, by the attainment of a high temperature, and not to effect the reduction of ore, it follows that a highly unreactive coke is needed, which will give little carbon monoxide with its accompanying heat absorption. A fuel like retort carbon, with extremely low specific reactivity at high temperatures, would be the ideal in this respect. This material gives only 30 per cent. decomposition of carbon dioxide at 1,500° C., with a contact time of about $\frac{1}{10}$ second.

The connection between the maximum temperature attained in an air-blown fuel bed and the reactivity of the fuel used has been the subject of discussion in the past. Korevaar[5] deduced that a reactive coke would give the highest temperature. He was led to this conclusion by his "law of heat compression." He regarded the effective reaction between carbon and oxygen as being

$$2\,C + O_2 \rightarrow 2\,CO + 58{,}000 \text{ cals.}$$

A reactive fuel in a furnace shaft would require a smaller volume in which to bring this change practically to completion. Because the loss of heat through the furnace walls is governed by the magnitude of this volume, he believed that less heat would be lost in this way by the more reactive fuel, and that therefore a higher temperature would be attained. The fallacy here lies in ignoring the part played by the comparatively slow reduction of carbon dioxide formed to carbon monoxide. The depth of fuel required for combustion to carbon dioxide is practically constant for all fuels. The next action, reduction of carbon dioxide to carbon monoxide, absorbs heat. With reactive fuels, the zone of heat absorption, not of heat evolution, is compressed into a smaller volume, with a consequently reduced temperature. This was demonstrated by Dent and Cobb,[6] who passed air at a steady rate through graded coke heated at 700°, and found the maximum temperature (980°) was attained with an unreactive beehive coke, and the minimum temperature (865°) with a highly reactive coke containing sodium carbonate.

Retort carbon is known to give a very high temperature when blown with air in a fuel bed. This is explained, as above, by its low reactivity and by the small increase in the reactivity of retort carbon with temperature, compared with that of cokes from bituminous coals.

The water-gas generator offers a special difficulty in the choice of coke, low reactivity and low carbon monoxide being advantageous in the blow, but high reactivity to steam during the run. High reactivities to steam and carbon dioxide usually go together,[7] so that the requirements of a water-gas coke appear at first sight incompatible. The difficulty partly disappears with the use of a waste-heat boiler for the recovery of sensible and potential heat from the blow gases; but because a therm is more valuable as gas than as steam, the fundamental incompatibility is not entirely avoided. The time of contact during the blow may be reduced by rapid blowing, or the use of a shallow fuel bed, but that involves the risk of channelling of the gases and low steam decomposition in the run.

Considering the blow alone, the time of contact has been estimated from data in the 6th and 27th Reports of the Joint Research Committee at about $\frac{1}{10}$ sec. This is the same time as that used in Figure 3, and is based on the assumption that a 5 ft. fuel bed is operative. The temperature of the fuel bed is altering during the blow, and is much lower than that of the blast furnace hearth. Consideration of Figure 3 shows that in this example the reactivity of the fuel may be important, leading to appreciable differences in blow gas composition.

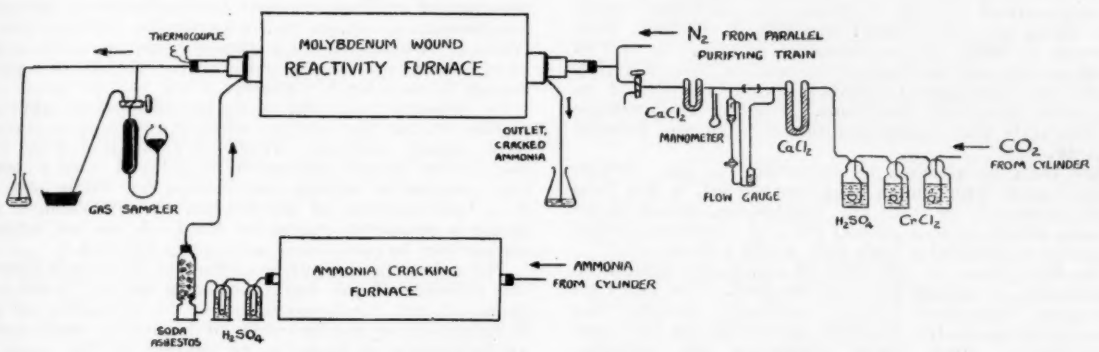


FIGURE 5.—*Apparatus for Reactivity Measurements at High Temperatures.*

For an air-blown producer a reactive fuel and a comparatively long time of contact are advantageous. Figure 4 shows that with two different cokes and a contact time of about 1 sec., fuel bed temperatures of 1,000° and 1,100° C. are necessary to give a gas rich in carbon monoxide, but that these temperatures become 1,200° and 1,350° C. when the contact time is reduced to $\frac{1}{10}$ sec. If steam is used the temperatures are lowered and the slower reaction of steam decomposition is involved, both demanding a more reactive carbon for optimum results.

It is plain, however, that the calculations as given above for these high temperature appliances are speculative. In each case we are concerned with a fuel bed with a large gradient of temperature, and one in which the effective time of contact is exceedingly difficult to estimate. It may be noted, however, that the effect of these factors, and of the use of coke of larger size, will in practice make differences in reactivity more effective than the calculations above would suggest. Direct experiment is called for in order to establish clearly the influence of reactivity as a separate factor in determining the results obtained.

In low temperature appliances the case is clearer. Taking the domestic fire as an example, the ease of ignition of each piece of fuel, its rate of rise to full redness, and its behaviour afterwards are all of direct importance in determining the appearance and radiant efficiency of the fire. Reactivity to oxygen and to carbon dioxide are both directly involved, the one at lower and the other at higher temperatures, and differences are markedly effective.

[4] Stahl u. Eisen, 1933, **53**, 144.

[5] "Combustion in the Gas Producer and Blast Furnace," 1924.

[6] Institution Gas Research Fellowship Report, Trans. Inst. Gas. Eng., 1926-27, p. 333.

[7] 22nd Report, Joint Research Committee. Trans. Inst. Gas Eng. 1929-30, Vol. 79, p. 50.

4th Report of the Liquor Effluents and Ammonia Sub-Committee

Research Chemist: A. KEY, Ph.D., B.Sc.; *Research Assistant:* W. ETHERIDGE, B.Sc.; *Temporary Research Assistant:* A. H. EASTWOOD, Ph.D.

Summary.

The most commonly used method of disposal of gas works waste liquors, and one which has given rise to difficulties in many places, is to treat the liquor mixed with sewage at a sewage treatment works. For that reason the Liquor Effluents and Ammonia Sub-Committee has thought it essential to make a detailed examination of the behaviour of liquors of various types during the sewage purification process and of their effect on the resulting effluent. The first part of the investigation was detailed a year ago in the Third Report of the Sub-Committee, where tests concerned mainly with the constituents of gas works liquors were described. An account of a further stage of the work, in which the liquors themselves have been considered, is given in the present communication.

An investigation such as has been made could not possibly have been carried out on anything but laboratory scale plants, which have been used throughout. Efforts have been made to relate the performance of these to that of full scale works, yet the Committee realizes that it is very desirable that the salient points brought out should be tested under practical conditions. Pending confirmation from such tests the conclusions can only be put forward tentatively.

Rather than to attempt to summarize in this Section the experiments which have been carried out, it has been thought preferable to state the conclusions, which in all cases have reference to a normal ratio of liquor to sewage, and to refer to particular tests only where necessary.

In the first place the influence of gas works liquors on the properties of sewage has been studied. The effect on the oxygen absorption (O/A), ammonia content and oxygen requirements for complete oxidation can be found by calculation, since these properties are additive. Examples are given. The magnitude of the increase in the biochemical oxygen demand (B.O.D.) caused by the liquors is approximately equal to the increase in the O/A, but in comparison with the B.O.D. of the sewage the effect is relatively small. This leads to the conclusion that in towns so situated that sewage purification is not required owing to an adequate volume of diluting water being available the problem of gas works liquor should not normally exist.

Gas works liquors, more especially crude liquors, tend to retard the development of offensive odours in sewage, but otherwise appear to have no important effect on the "settling" process. In particular the response of sewage itself to biological treatment is not altered by any change brought about by gas works liquors during settling. The possibility of gas works liquors themselves contributing towards the odours from a sewage is discussed. Any trouble in this direction can generally be minimized by running the liquor at a controlled rate into a sewer which carries a large volume of sewage.

To understand the oxidation of the liquors themselves in presence of sewage it is convenient to divide the constituents into the following classes: Phenols, catechol, other tar soluble bodies, thiocyanate, ammonia and sulphide. Thiosulphate may usually be neglected, being relatively small in quantity and easily oxidized. It appears, too, that sulphide, in normal concentration, is of little importance, since its removal did not bring about any improvement in the character of the purified sewage liquor mixture. If the sulphide concentration or the dose of liquor is abnormally large it is possible that sulphide may have a very pronounced adverse effect.

Of the other constituents phenol added to sewage is easily oxidized, both in the presence and absence of ammonia, and numerous experiments showed that the dephenolation of both crude and spent liquors brought about no significant improvement in the effluents from biological treatment. Both devil liquor and concentrated liquor, being mainly phenolic in character, are also easily oxidized, and the presence of the former in spent liquor does not influence the character of the purified sewage-liquor mixture.

Thiocyanate is only dealt with successfully by sewage purification media which have become acclimatized to the presence of this substance. The oxidation of thiocyanate has been the subject of a more detailed investigation which is described in the Report. The products of oxidation are ammonium sulphate and carbon dioxide, and the efficiency of the process is very sensitive to changes in the concentration of the thiocyanate. In the case of liquors containing considerable quantities of this substance it is therefore of great importance that the percentage of liquor in the sewage should be kept constant.

Whilst under very favourable conditions complete oxidation of all the constituents of gas works liquors may occur, usually the oxidation proceeds to a certain point and then almost stops, leaving what has been termed an "O/A residue," which remains almost constant even after prolonged treatment. The O/A of this residue is added to that of the sewage effluent, hence in general the O/A of a purified sewage-liquor mixture is rather greater than that of the corresponding sewage. The O/A residue originates in the tar soluble bodies other than phenols and catechol, although it may contain thiocyanate if purification of this substance has not been established. The residue is proportional to the higher tar acid content of the liquor, being greater for vertical than for horizontal retort liquors, but it also seems to be influenced by the condition of the purification medium. A study of the residue showed that it had no appreciable B.O.D. and this led to a series of tests, as a result of which it was found that the influence of a spent liquor on the B.O.D. of a sewage became negligible before the purification of the sewage was complete. The importance of this observation lies in the fact that the B.O.D. test, being a biochemical test, gives much more significant results than does the O/A. The presence of ammonia retards the oxidation of most of the constituents of liquors and in particular increases the O/A residue. A crude liquor is therefore not so easily oxidized as is a spent and its influence on the B.O.D. of a purified sewage is considerably greater.

In bacteria beds the oxidation of liquors takes place rapidly in the first section when the sewage is also being most rapidly purified. With activated sludge the oxidation of the liquors appears to be delayed until a considerable amount of sewage purification has taken place, but with both systems of purification the oxidation of spent liquor is complete, except for the O/A residue, before the sewage can be considered sufficiently purified.

The colour in the purified effluents sometimes caused by the presence of gas works liquor in sewage is due to the chemical, not biochemical, oxidation of higher tar acids. A reduction in the quantity of higher tar acids present, an avoidance of unnecessary contact of the liquor with air, and the removal of ammonia, to give a less alkaline reaction to the liquor, all tend to reduce the intensity of the colour formed.

In the Third Report it was concluded that a particularly suitable spent liquor for treatment in admixture with sewage would be that from a crude liquor originating in gas which, while still above the dew point, is subjected to the action of an efficient tar precipitator, and which is kept free from oxygen until it enters the purifiers. Although such a liquor would have a high phenol content it would be almost free from higher tar acids, thiocyanate, and thiosulphate, and would therefore be easily oxidized. The development of the investigation which is reported here supports this conclusion at all points. It also suggests that the ammoniacal liquor from such a system, although not so easily oxidized as the spent, would be more suitable for treatment with sewage than other crude liquors.

Ammonium Bicarbonate.

In a general introduction to the Report, Professor Cobb states that:

The advisory work of the Committee, as rendered to individual companies and authorities, is often of special importance, and at times receives the recognition due to it. It is done through the Chairman and the Research Chemist, and the accumulation of knowledge from dealing with a number of cases, and from the examination of samples involved, should be of increasing benefit to the Industry. The questions raised, which relate primarily to sewage treatment and the conveyance of gas-liquor in sewers, required the inspection of plant as well as the examination of samples.

As regards Ammonia, the work of the Committee has centred chiefly on Ammonium Bicarbonate. A considerable amount of laboratory experimental work was carried out by Dr. Eastwood in an attempt to examine the pro-

cess proposed by Dr. Key, as far as it could be examined on the laboratory scale. As the next step it was thought desirable to appoint a Sub-Committee "to consider the practical and commercial advantages and disadvantages of the several ammonium bicarbonate processes as compared with each other and with ammonium sulphate." This Sub-Committee has not yet made its final report, but it may be said that the rise in price of sulphate, the fall in price of acid, and the increase in the production of concentrated ammonia are tending to make the prospects of ammonium bicarbonate production relatively less favourable than they appeared some time ago. One important factor in this situation is the uncertainty which still exists as to the comparative value of bicarbonate and sulphate as fertilizers. Field experiments on various crops carried out by the Rothamsted Experimental Station were inconclusive in this respect, having been made in an exceptionally dry season, and it is felt by the Committee that this uncertainty must be removed before the relative commercial positions of ammonium bicarbonate and sulphate as fertilizers can be established.

Report on Replies to Questionnaire on Liquor Effluents and Ammonia.

Introduction.

A Questionnaire on Liquor Effluents and Ammonia was circulated at the end of July, 1934, to all undertakings making more than 50 Mn. cu.ft. of gas per annum. The Questionnaire was planned to obtain information regarding the general practice of ammonia recovery and effluent liquor disposal at present obtaining in the different-sized works, to ascertain how far the various recommendations of the Liquor Effluents and Ammonia Sub-Committee had been carried out, and to find out how widespread were the difficulties which are associated with effluent liquor disposal.

The Questionnaire.

(1) Name of Gas Undertaking.
(2) Type of carbonizing plant in use.
(3) Tons of coal carbonized per annum.
(4) (*a*) Type of condensing, washing, and scrubbing system.
(*b*) Strength of liquor made.
(5) (*a*) How is ammonia liquor stored?
(*b*) Is it kept out of contact with tar?
(*c*) What steps, if any, are taken to minimize contact with air?
(6) Do you recover ammonia, free or total, from the ammoniacal liquor, and, if so, in what form?
(7) If the ammonia is recovered, how do you dispose of the spent liquor, and, if any, devil liquor?
(8) (*a*) If the ammonia is not recovered, how do you dispose of the crude liquor?
(*b*) Have you considered the possibilities of producing concentrated liquor?
(9) If either the crude or effluent liquor is disposed of by way of the sewers—
(*a*) What is the ratio of liquor to sewage (dry weather flow)?
(*b*) To what type of treatment is the sewage subjected (*e.g.*, no treatment, simple settling, bacteria beds, activated sludge, land filtration, &c.)?
(*c*) Do you take any special precautions in, or subject the liquor to any special treatment before, admitting it to the sewers (*e.g.*, regulating flow during the day, admitting only at certain hours, any preliminary treatment of liquor, &c.)?
(*d*) Do you receive complaints from the Sewage Authority about the effect of the liquor, and, if so, in what connection (*e.g.*, colour, oxygen absorption, frothing, deposit in sewers, &c.)?
(10) Do you make any attempt—
(*a*) To minimize the volume of liquor produced?
(*b*) To reduce its higher tar acids content by early separation of tar and liquor?
(*c*) To reduce its thiocyanate content by admitting air after, instead of before, the washers and scrubbers?

The Replies.

Out of 479 undertakings to which the Questionnaire was sent, and which carbonize in all over 16 Mn. tons of coal per annum, replies were received from 264, or 55 per cent. of the total. The proportion of larger undertakings replying, however, was much greater than that of the smaller, so that the answers as a whole covered over 80 per cent. of the coal carbonized. The replies showed that the proportion of ammonia dealt with in the various ways is as follows:—

	Per Cent
Ammonia from 7,759,000 tons recovered as sulphate	= 56·2
,, ,, 1,473,000 ,, ,, ,, concentrated liquor	= 10·7
,, ,, 2,357,000 ,, disposed of to chemical works .	= 17·1
,, ,, 2,206,000 ,, wasted as crude liquor . . .	= 16·0
	100·0

These figures are subject to a small error, since the fact that some undertakings, particularly those making concentrated liquor, no longer recover fixed ammonia has not been taken into account in the calculation.

Thus it appears that the ammonia which is being wasted, owing to its fall in value, is about one-sixth of the total, while more than half is being directly converted to sulphate at the gas works. The latter is the practice at most of the larger works, although a few of these make concentrated liquor or dispose of their ammoniacal liquor to nearby chemical works. In the small works very few sulphate plants are now in operation, a large number of undertakings carbonizing less than 20,000 tons per annum making no attempt whatever at ammonia recovery. The proportion of undertakings disposing of crude liquor to chemical works varies little with the size of works, and averages 17 per cent. The production of concentrated liquor appears to be most popular at works carbonizing between 20,000 and 50,000 tons per annum, 60 per cent. of the plants reported coming in this range. At a few works which are now wasting ammonia the installation of concentrated liquor plants has either been decided upon or is being seriously considered.

In answer to a question as to whether the production of concentrated liquor had been seriously considered about 20 per cent. of the undertakings replied that it had, but the conclusion had been reached that it would not be economical or advantageous under the present circumstances. This can readily be understood in the case of works sufficiently large to manufacture sulphate economically or where a suitable chemical works lies adjacent to the gas works. Other works stated that difficulty would be experienced in marketing the concentrated liquor or in disposing of the spent liquor, while some were of the opinion that the capital cost of the necessary plant was too high to make the process economical. A further 20 per cent. of the undertakings replied that the question of concentrated liquor had been considered, but did not state what conclusion had been arrived at. The majority of works which are not recovering ammonia, however, have not given consideration to the possibilities of concentrated liquor, which is disappointing in view of the repeated recommendations of this Committee on the matter.

The liming of ammoniacal liquor to recover fixed ammonia is still generally practised at works making sulphate, but where concentrated liquor is produced it is the custom to distil the free ammonia only.

It is surprising to learn that only about 40 per cent. of the undertakings which distil their own liquor make any attempt to minimize its volume, although steam costs for distillation are almost directly proportional to this quantity. When crude liquor is sent away for treatment the influence of quantity is usually much more serious, due to transport charges, and this is reflected in the fact that 65 per cent. of such works attempt to minimize the volume of liquor produced. In these cases the final disposal of the effluent liquor is not the concern of the gas works, and in very few instances is any attempt made to reduce its polluting character. Even when liquor, ammoniacal or effluent, is disposed of directly from the gas works only about 25 per cent. of the undertakings report reduction of the higher tar acid content by early separation of tar and liquor, or of the thiocyanate content by admitting air after instead of before the washing and scrubbing system.

The most widely adopted means of disposal of spent liquor is to admit to the local sewers, when it is treated with the other liquid wastes of the district. This is usually the most satisfactory method of disposal. Nearly one-third of the undertakings, however, adopt other and at times less desirable methods, although the majority of such works are small ones. Without going into detail regarding such methods, it can be said that while some of them, properly operated, are open to no objection, others may give rise to difficulties and complaints.

The oxygen absorption, colour, and liability to produce foam are the properties of a sewage or sewage effluent which

are most readily affected by the presence of gas works liquors, and this is shown by complaints made on these points. There are cases in addition, however, where the effect of gas works liquor on the smell of sewage and the occurrence of deposits in the sewers have given rise to complaint. Usually it is ammoniacal liquor which is held responsible for the effect, but occasionally spent liquor which has been limed has been alleged to cause deposits of calcium carbonate in sewers.

It should be noted that the Committee in its work has paid attention to each cause of complaint, and the majority of them are dealt with in some detail in the Report.

34th Report of the Joint Research Committee of the Institution and Leeds University

Corrosion from Products of Combustion of Gas.—Part II. Tube Experiments

Research Chemist : JAMES W. WOOD, M.Sc.Tech., A.I.C.;
Research Assistant : E. PARRISH, M.Sc.Tech.

The investigation is directed to the examination of the action of products of combustion of coal gas upon various materials used in the construction of gas appliances.

Two sets of experiments are described in which a number of metal tubes were simultaneously subjected to the continuous action of products of combustion for periods of approximately one month and three weeks, respectively, the conditions of attack being as nearly as possible identical for the various materials.

The tubes (15 in. by 1 in.) were made from commercial sheet metals and were surrounded by water-jackets maintained at 40-60° F., whereby some 80-95 per cent. of the water produced by the combustion of the gas was condensed on the inner surface of the tubes; this, together with the sulphur and nitrogen acids dissolved therein, formed the corroding medium. The metals used are indicated in Table 1.

The gases used were (i) a town gas, calorific value 470 B.Th.U. per cu.ft., containing 25-30 gr. of sulphur per 100 cu.ft.; (ii) the same gas with the sulphur content increased to about 50 gr. by the introduction of carbon bisulphide.

In most of the experiments the bulk of the corrosion product was either soluble, or a readily detachable solid, which found its way into the vessel for collecting the condensate. The amount of condensate and the concentrations of metal, sulphur and nitrogen acids therein were determined for periods of three days. At the end of a group of tests the tubes were cut open for examination.

For given concentrations of sulphur acids in the products of combustion few of the metals showed a uniform rate of corrosion throughout the course of the experiment, much apparently depending upon the formation, or otherwise, of a protective coating. For this reason, the *average* rates of attack, given in Table 1, must be used with caution, and with due regard to the shapes of the individual corrosion curves in Figures 1 and 2.

The metals examined fall into three main groups, as indicated in Table 1, exhibiting good, medium, and poor resistance to attack, respectively, under the conditions of the tests. Variation in experimental conditions might alter the order of materials within these groups.

The sequence of metals was not materially altered when the sulphur content of the gas was raised from about 25 to about 50 gr. per 100 cu.ft. In most cases the absolute amount of corrosion was increased by this change, but not in proportion to the higher sulphur content of the gas, except in the case of the most readily attacked materials.

The amount of sulphur retained (mainly as free and combined sulphuric acid) in the condensates varied from 4-10 per cent. of that contained in the gas in the case of the resistant materials, to from 50-90 per cent. in the case of those most easily attacked. This confirms the statements made in the 33rd Report of the Joint Research Committee.

Irrespective of the total amount of corrosion, the conden-

TABLE I.—*Summary of Corrosion Tests.*

Average Operating Conditions.	Test Period. Ia.	Ib.	II.
Duration of test in days	15	12	21
Gas consumption, cu.ft. per tube per day	11·94	11·66	12·21
Sulphur content of gas, grains per 100 cu.ft.	26·1	25·6	51·2
Water produced by combustion of gas, c.c. per cu.ft.	19·2	19·4	20·2
Water condensed as percentage of that produced by combustion of gas, per cent.	79	91	94
Concentration of CO_2 in flue gases, per cent.	4·6	5·0	7·3
Dilution factor†	10·9	6·3	6·5
Sulphur content of flue gases, grains per 100 c.ft.	2·39	4·09	7·93

Material.	Sulphur Retention in Condensate, Per Cent ‡ Ia.	Ib.	II.	Metal in Condensate, Gms. per 100 Cu.Ft. of Gas Burned. Ia.	Ib.	II.	Total Weight of Metal Lost During Test, in Gms. Ia + Ib.	II.
1	2	3	4	5	6	7	8	9
Lead	4·6	9·6	7·1	0·015	0·013	0·008	0·15	0·12
Tin	5·2	8·2	6·5	0·004	0·006	0·007	0·02	0·02
Solder (1)	4·5	7·8	6·6	0·018	0·023	0·014	0·06	0·04
Solder (2)	..	..	5·9	..	..	0·012	..	0·03
Aluminium	18·4	19·3	15·4	0·19	0·18	0·23	0·59	0·58
Chromium plate	23·1	27·0	..	0·59*	0·65*	..	1·97*	..
Nickel plate	46·0	38·3	..	1·20*	0·92*	..	3·44*	..
Brass (70/30)	41·8	37·8	26·9	1·15	0·86	1·43	3·27	3·66
Copper, hard (1)	61·2	42·3	29·0	1·59	0·97	1·54	4·20	3·96
Copper, hard (2)	..	..	19·3	..	..	1·16	..	2·98
Copper, soft	63·8	47·2	31·5	1·71	1·01	1·70	4·49	4·36
Iron, black	42·8	51·2	61·5	1·35	1·54	3·27	6·67	11·22
Iron, galvanized	71·0	82·9	76·6	2·61	2·84	4·53	8·75	12·56
Zinc	65·1	89·5	89·9	2·52	3·33	6·07	9·16	15·56

NOTE.—Tests Ia and Ib were consecutive and on the same specimens of material, while for Test II, fresh specimens were employed.

* Chiefly copper.

† Cubic feet of dry flue gases (*i.e.*, products of combustion + excess air) per cu.ft. of gas burned.

‡ Sulphur in condensate as percentage of sulphur in gas burned.

sates usually showed the presence of free acid to the extent of 0·01-0·04 gm. per 100 c.c., the acidity being expressed as sulphuric acid.

The amount of oxidizable material in the condensates was very small. Iron forms an important exception, the corrosion product being almost wholly ferrous sulphate in the first place, this subsequently oxidizing and throwing down a precipitate of basic sulphate and hydroxide.

Nitric acid was found in all the condensates, but was much more constant in amount than the sulphuric acid. The amount, however, represented a conversion and retention of some 2-3 per cent. only of the NO produced during the combustion of the gas, and 0·004 gm. of nitric acid per 100 cc. of condensate was typical. There was a tendency for the amount of nitric acid to be lower with the gas of higher sulphur content, but apparently no quantitative relationship between the two.

The present practice of using lead, tin, and solder for protective coatings is justified, but attention should be directed to the technique of applying such coatings in a sound adherent condition, and of greater thickness and uniformity than is frequently the case. Zinc, black-iron, and galvanized iron are clearly quite unsuitable materials for use where contact with acid condensates is likely to occur. The experiments with chromium plate and nickel plate are inconclusive.

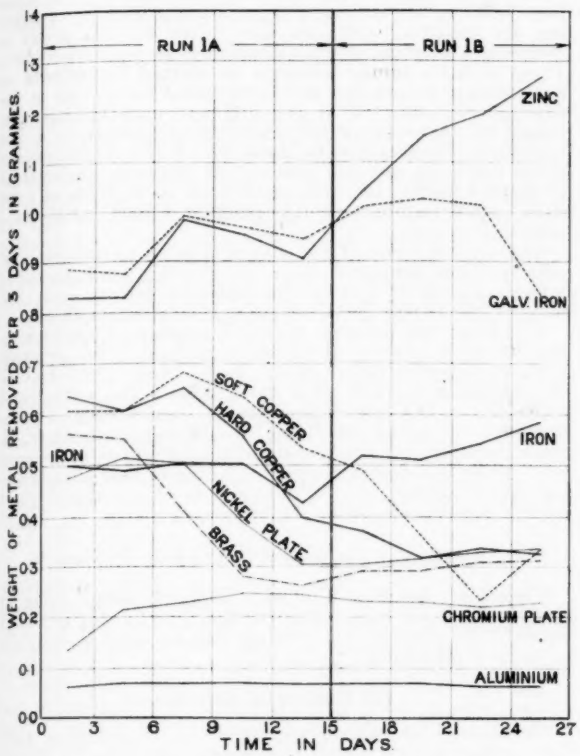


FIGURE 1.—*Corrosion Curves, Runs Ia and Ib.*

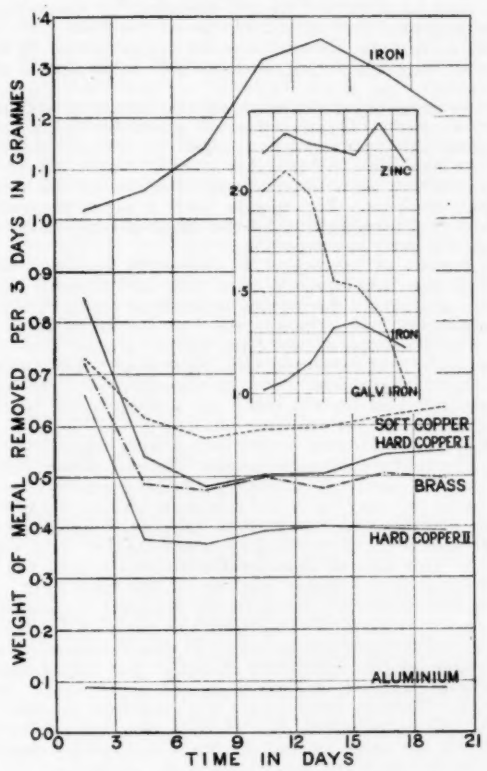


FIGURE 2.—*Corrosion Curves. Run II.*

25th Report of the Refractory Materials Joint Sub-Committee

On July 31st, 1934, the Institution issued a new edition of "Standard Specifications for Refractory Materials for Gas Works," which cancelled all previous editions of this specification. During the preparation of this revised specification fullest consideration was given to the question of including a specified test for the determination of the refractoriness-under-load characteristics of refractory materials, but it was eventually decided that further research on this test was required before a particular procedure could be laid down. This course was followed because there are such wide variations in the different methods and procedures employed, although it was recognized that the test yields information of great value and is widely used.

It is for this reason that a substantial part of this year's report is concerned with the subject of the testing of refractoriness-under-load. The first section is mainly a critical review of the methods in vogue, not only in this country but in America and on the Continent. The American practice aims at determining the behaviour of a refractory material under load on heating to a prescribed temperature which is then maintained for a definite period. Two standard-sized bricks are so treated in the same furnace. As a great contrast, in the German and French methods a small specimen is heated under load until failure occurs. The size of specimen prescribed in the German Industrial Specification (DIN 1064) is a cylinder measuring 50 mm. by 50 mm., while in France still smaller test pieces are employed. The practice in this country is in the main similar to that followed in Germany, but larger test pieces are used, viz., 3½ in. by 2 in. by 2 in. Two main issues are thus apparent.

1. Should an under-load refractoriness test be preferably carried to the temperature of complete failure, or merely maintained at a value comparable to that at which the material will be put into service?
2. What is the best size of test piece?

Closely connected with this latter question is the rate of rise of temperature to be adopted. Other variations in the procedure for carrying out the test, such as the value of the load, the method of measuring the temperature and recording the expansion or subsidence of the test piece, although of great importance, are probably of subsidiary interest.

It is pointed out in the same Section that, in the type of test where the temperature is raised until the specimen fails, the data of chief importance are (1) the temperature at which softening commences, (2) the temperature when softening accelerates, and (3) the temperature of failure.

The second section of the report of the work carried out by the British Refractories Research Association is concerned with experimental work bearing on several of the questions suggested in the preliminary review. The work relates entirely to the type of test where failure of the specimen results, and it is shown that the recorded temperature of failure may be increased by as much as 100° C. when the test piece is heated at 15° C. per minute com-

pared with 3° C. per minute. This refers to test pieces of 4 sq. in. cross section. Similar effects are obtained by varying the area of cross section of the test piece. Evidence is given to show that variation in the gradient of temperature within the test piece is largely responsible for these divergent results. Experiments are also described which show how the form of the temperature-deformation curve may be distorted by not allowing for the expansion of the supports and thrust blocks in the furnace. When this correction is disregarded the temperature of initial softening may appear as much as 300° C. in excess of the true value.

In continuation of the work on the action of alkalies on refractory materials, a report is given of the action of potassium chloride vapour at 1,000° C. In the absence of moisture the silica refractories notably resist attack to a greater extent than fireclay, which confirms the findings of other workers. The results form a starting point for the projected investigation of the effect of temperature and of moisture on these reactions.

The section of the report dealing with jointing cements describes the development of a test for gauging the behaviour of cements during the heating-up and operation of an installation. In principle the test measures the expansion or deformation of two ¼ in. joints between three brick blocks while it is subjected to a light load. The breaking strength of the joints can subsequently be determined. The method has been applied to a variety of synthetic cement mixtures with a silica base.

In last year's Report, experiments were described relating to the texture of silica bricks. It was shown how the porosity and permeability to air of the products were dependent on the grading of the raw mix, and on the pressure used in making. In this Report sillimanite bricks bonded with 10 per cent. of the ball clay are treated in a similar manner. One fact of considerable interest is that the size-composition of the finest portion of the mix (*e.g.*, that passing through an 80's mesh sieve) can exert a considerable effect on the texture of the product as revealed by porosity and permeability measurements. In investigating the effect of pressure on the sillimanite mixes it was found that an appreciable decrease in the proportion of the larger grains occurred. This at once raises the question whether the grading to be adopted for machine-pressed products is necessarily the same as that for hand-tamped articles when minimum porosity and permeability are desired.

The report on high porosity silica bricks is occasioned by the possible field of usefulness for such products as high-temperature insulating materials. Small experimental blocks having a porosity of over 55 per cent. and a refractoriness-under-a-load of 25 lb. per sq. in. in the neighbourhood of 1,700° C. have been prepared. It was also found possible to prepare coherent test pieces of silica bricks having a porosity of 66 per cent. This was achieved by suitably grading the ganister and incorporating 40 per cent. by weight of similarly graded coke in the mix.

A short note on the effect of the addition of steatite to fireclay mixes shows that, when suitably fired, the thermal expansion of the product between ordinary temperatures and 1,000° C. may be reduced to one-half. Some decrease in refractoriness naturally results.

DIGEST OF REPLIES TO A QUESTIONNAIRE ON THE DURABILITY OF REFRACTORY MATERIALS IN GAS WORKS.

By A. T. Green, F.I.C., and F. H. Clews, M.Sc., A.I.C.

Introductory.

At the instigation of the Refractory Materials Joint Sub-Committee of The Institution of Gas Engineers, the Society of British Gas Industries and the British Refractories Research Association, a Questionnaire on the Durability of Refractory Materials in Gas Works was circulated to certain gas undertakings, that are members of the British Refractories Research Association. The aim of the Questionnaire was to obtain guiding information for the workers engaged in the research on refractory materials for the Joint Sub-Committee. The response has been particularly encouraging, forty-five undertakings giving detailed data of over ninety plants.

Most of the information is of a confidential nature and intended solely as a help to the research staff in their investigations. This section is a digest of certain information on topics of general interest.

The Life of a Retort Setting.

The term "life" is taken to refer to the number of working days for which the setting has been in operation from the initial building to the final dismantling.

The average term of life of a horizontal retort setting would appear to vary considerably. The highest average figure quoted is in the region of 2,500 days, while the lowest is about 1,000 days. The general average from the whole of the replies received is about 1,700 days. Nevertheless it would appear to be a fairly common experience for individual lives to be considerably in excess of 2,000 days, and several respondents have quoted instances where over 3,000 days' service has been obtained.

On the average it seems possible to obtain a life of about four years before extensive repairs other than mere pointing are essential, although many undertakings prefer to overhaul the plant more thoroughly at an earlier date. There is little in the evidence submitted to indicate an outstanding reason for the appreciable variations in the average life obtained at the different undertakings; certainly the severity of the carbonizing conditions is not necessarily connected with shortness of life. Instances are given where an average combustion chamber temperature of about 1,250° C. has only yielded an average life of 1,200 days, while installations operating at nearly 1,400° have lasted 2,000 days.

The general trend of the replies appears to indicate that siliceous and segmental silica retorts are giving somewhat longer periods of service than fireclay retorts and this, despite the usually more severe carbonizing conditions.

A similar and perhaps greater variation is apparent in the average lengths of service obtained from different vertical retort settings. These range from 1,000 days as the minimum to well over 3,000 days. The extent and character of the intervening repairs, amounting in some instances to partial rebuilding, would seem to account, in large measure, for this considerable difference in average life. From the replies received it would appear that five to six years' service may be obtained from a vertical retort setting before extensive rebuilding is required.

The General Causes of Failure of Retorts.

Under this heading are considered the prime cause or causes which are responsible for the retort being regarded as unfit for further gas making and to require complete or partial rebuilding.

(*a*) *Horizontal Retorts.*

Ultimately, of course, any retort is regarded as unfit for further service when it is unable properly to deliver the gas generated in it, or stands in imminent danger of being unable to do so. It was upon the causes leading to this condition that the opinion of the gas makers was sought. There is not much unanimity in their views. The abrasion of the bottom of the retort arising from the action of the machine in discharging coke and charging coal is perhaps most generally regarded as one of the most important causes leading to the wearing out of retorts, although only a few respondents would give it the first place.

On the other hand, faulty joints are blamed by some. Although instances of unsuitable jointing material have been reported, the defects at these points are more commonly attributed to the stresses set up by the shutting down and re-heating of the setting, and also, more particularly with silica segmental retorts, the spalling of the corners and edges of the segments occasioned by the temperature fluctuations. Incorrect allowances for expansion may also be included in this category. A further cause, mentioned in several replies, and regarded in a few cases as the primary cause of ultimate failure, is the slagging action of the producer gases on the material of the retorts and of the joints. In the region of the mouthpiece, temperature fluctuations and abrasive action both combine to make this locality liable to more rapid deterioration.

All the above factors play their part in causing the failure of retorts, and it would seem that no single cause can be considered generally as primarily responsible, but that each may assume major importance under the very varied conditions obtaining in working this type of retort.

(*b*) *Vertical Retorts.*

Over the whole retort there is, of course, the abrasive action of the charge and the slagging action of the flue dusts which must eventually set a period to the life of the retort, but the failure of vertical retorts would appear from the replies received to be generally zonal in character. There are two chief zones which develop. The first is in a region of about 6 to 12 ft. from the top of the retort, which has come to be regarded as the zone of flaking or spalling. (The discussion of the antecedent causes of flaking follows in a later section.) This defect may ultimately develop to such a degree that it is necessary to shut down the setting. However, in some cases, this type of decay of the brickwork may become arrested. In any case the roughened flaked surface is liable to give rise to the holding of the charge which, particularly with swelling coals, is liable to cause distortion of the retort and to open

joints. The replies also refer to the tendency in this zone for joints to fail through imperfect adhesion to the brickwork and the elimination of the jointing cement by mechanical means.

The second important region where failure is reported is in the bottom courses. Here, the slagging action of the coal ash, enhanced by steaming, and probably by the abrasive action of the coke, may result in the thinning of the walls and even ultimately of holing.

Flaking and Scurfing.

(*a*) *Horizontal Retorts.*

Considerable variations in the period of scurfing appear to be practised which range from four to eighteen weeks. Differences in the class of coal carbonized, the retort output, the working temperatures, and the material of construction of the retort, may in large measure account for this. Six to eight weeks would seem to be an average interval between scurfings. The general method of procedure is to use natural air circulation to loosen or partly remove scurf, followed by the use of the chisel bar. In a few instances an artificially induced air draught is employed, although more commonly the circulation is controlled by means of the retort doors.

The general impression obtained from the replies is that scurfing is unavoidably somewhat deleterious. The mechanical damage caused by scurfing tools being too harshly applied is mentioned as being partly, if not mainly, responsible for such deterioration in the condition of the retort as occurs at scurfing times. On the whole, scurfing is not regarded as more than a slight contributory cause in the ultimate failure of the refractories of this type of setting.

(*b*) *Vertical Retorts.*

Scurfing is usually practised at intervals of from anything between three and ten weeks. In general, the process is one of admission of a gentle current of air at the bottom of the retort, the control of which is made by the adjustment of the bottom and top openings, although, in a few cases, admission of air seems to be from the top. Slight steam injection during scurfing is commonly practised. There is fairly general agreement that, during scurfing, the temperature should be carefully controlled, and that overheating and undercooling should be avoided. The use of scurfing tools is usually restricted to a minimum.

About one-fifth of the plants report no trouble due to flaking. The remainder are in general agreement that the flaking zone is 4 to 12 ft. from the top of the retort, *i.e.*, in the silica brick courses immediately below the fireclay. The following views on the causes of flaking are included:

(i) Temperature fluctuations and high local temperatures during scurfing.

(ii) The steep temperature gradient between the flue and the coking faces at this zone of the retort. It is at this zone that the relatively cold coal comes into contact with the hot retort and any irregular movement of the coal only accentuates temperature contrasts and spalling conditions. One reply points out that the flaking corresponds to the level at which the coal becomes plastic. The plastic state permits of good contact with the retort face and of irregular downward travel.

(iii) The action of alkali chlorides. It is suggested that alkali chlorides injuriously react with the retort at this level and promote a tendency to spalling.

(iv) The action of the ash present in the scurf. A few contributors are of the opinion that on oxidizing the carbon of the scurf, the residual ash fluxes with the retort material with which it is in contact under the action of local high temperatures, and forms a surface layer differing from the underlying brickwork, which is thus predisposed to spall away in the form of more or less thin flakes.

Of these various opinions, the majority (where they express views at all) are inclined to favour (i) and (ii).

There is a general agreement that scurfing if carried out carelessly reduces the life of the retort. While the replies from a few plants record the opinion that if carefully done, the deterioration suffered by the retort is negligible, a greater number consider that some deterioration from this cause is inevitable. It is pointed out:—

1. There are rapid fluctuations in temperature due to the effects of cold air currents and high local temperatures consequent on the combustion of scurf. This is considered by some to promote flaking.

2. The general lowering of the temperature of the retort as a whole during the scurfing process results in subsidence, and on resuming normal working expansion occurs. This tends to open joints.

3. Local high temperatures developing during scurfing may also tend to destroy jointing material and warp panels. Leaks so initiated rapidly develop on further working.

4. Further strains are set up in the retort when, after scurfing, it is filled with cold, and possibly damp, coke.

Effects Dependent on the Nature of the Coal, &c.

(*a*) *Horizontal Retorts.*

The effect of the size of the coal on the durability of the refractories has apparently not received much consideration. The general impression is that too large a coal is mechanically injurious to the retort, while one which is too small affects the refractory by introducing greater temperature fluctuations. There is general agreement that Durham coals require higher carbonizing temperatures. Opinions are divided as to the effect of this coal on the life of the retort, but the majority consider that it decreases the life.

The replies to the Question regarding the effect of coal ash on the working behaviour of horizontal retorts indicate that little data is available. It is, of course, agreed that producer refractories suffer when the coal and coke contain an undue proportion of ash, particularly when this is rich in fluxing constituents. A few consider that the action is practically confined to that part of the plant. There are more, however, who consider that the fluxing action is more general, affecting the uptakes and combustion chambers and sometimes fluxing the retorts proper. The last mentioned action would seem to be more pronounced with silica material. There is little reference to the corrosive action of ash within the retort during working or scurfing periods.

(*b*) *Vertical Retorts.*

The presence of fines in coal is generally considered a disadvantage due to sticking and attendant troubles of temperature fluctuations, high gas pressures, and the necessity for rodding. The high ash content is also considered deleterious. One reply suggests that scurfing should be more frequently done when the coal size is reduced.

Durham coals appear to give more difficulty in vertical retorts than in horizontal, because their swelling action produces strain and promotes irregular working with its attendant troubles. More frequent scurfing may also be required. When blended with non-swelling coals they can be satisfactorily carbonized.

Producer linings suffer by an undue ash content of the coke, and the flue dusts act corrosively on the retorts more particularly when leaks develop. There is also increased corrosion on the interior of retorts in the steaming area. Both these effects have been reported as leading to the ultimate shutting down of the setting.

Steaming is not generally considered as greatly increasing the corrosion of the retort, although a significant minority think otherwise. These have observed an adverse effect due to erosion by entrained dust and the carrying forward of volatile corrodants. Too high bottom temperatures in conjunction with high steaming may cause disintegration. The scouring action of the coke is more pronounced in the steaming zone when ash contents are high.

Reconditioning—Hot and Cold Patching.

(*a*) *Horizontal Retorts.*

(i) *Hot Patching.*—Hot patching is apparently regularly practised on the majority of horizontal retort plants. Only about one-tenth of the replies received indicate that hot patching is considered of doubtful service.

The method most commonly employed is that of applying the cement in a putty-like consistency by means of a paddle. References are made to wastage of cement and the difficulty of making effective patches in certain portions of the retort where it needs considerable effort to obtain sufficient pressure on the paddle.

A large variety of cements is in use varying from plastic adhesive fireclay preparations to highly siliceous mixtures with just sufficient clay to give workability and fired strength. A number of proprietary cements appear to give general satisfaction.

(ii) *Cold Patching.*—Advantage is commonly taken of every occasion on which the retorts are let down, usually each year in the summer months, to recondition them. Defective portions are cut out and new pieces of retort material of the required size bedded in with a refractory cement. In the case of segmental retorts, defective segments are removed and new ones fitted. All joints and cracks are raked out and filled by hand with cement selected according to the type of retort. A final refractory cement wash is commonly given. This type of treatment is generally accepted as worth while, as it is reported to prolong the useful life of the retort, but resurfacing defective or worn portions of the retort with plastic cements does not appear to find much favour.

(*b*) *Vertical Retorts.*

(i) *Hot Patching.*—Hot patching of one kind or another would appear to be regularly practised by the majority of

these plants after scurfing. In the holing zone at the bottom of the retort, the larger leaks are stopped by means of cement manipulated by means of a paddle or a gun, considerable skill being required. The cement gun finds a few enthusiastic advocates for stopping leaks. A refractory cement spray may then be used over the whole of this zone. In order to assist in the location of leaks and to test whether the patching has been effective it is usual to apply extra producer gas pressure and observe the flames (if any) of burning producer gas in the retort. In the spalling and flaking zone towards the top of the retort some measure of success in checking the deterioration of the brickwork is reported with the use of a spray worked from the top of the retort, if the treatment is regularly adopted. In some vertical plants, the paddle method is employed as a means of filling conspicuous leaks.

The general consensus of opinion seems to be that repairs by the hot patching methods at present available are by no means permanent, and need to be regularly repeated. They are, on the whole, however, worth while and extend the working life of the retort. Stopping leaks is easier than re-surfacing spalled areas.

Some proprietary cements appear to give satisfaction.

(ii) *Cold Patching.*—Cold patching frequently amounts to rebuilding certain courses, often in the spalling zone. For the remainder the joints are raked out, and refilled, defective portions cut out and new pieces, cut to shape, cemented in position. A final wash with a suitable cement is usually given. Such reconditioning is regularly carried out by many undertakings, but the frequency shows considerable variation. Very limited success has attended attempts to resurface spalled areas in the cold condition, although one attempt using a plastic mixture of seven parts of silica (ganister or brick) and three of a siliceous cement had limited success. The cold patch was almost all detached by the end of the first scurfing period, but the condition of the retort was noticeably superior to those not so treated. One or two cases, in which the settings are let down regularly every year for the purpose of cold patching; are reported.

Initial Heating-up and Expansion Stresses.

(*a*) *Horizontal Retorts.*

Comparatively few instances are reported of expansion stresses set up during the initial heating causing serious cracking and failure of retorts. All reported cases would seem to be with silica or siliceous materials, although satisfactory working is the rule. One report referred to arch lifting, but a more common trouble is cracking in silica retorts at points varying between 1½ ft. and 3 ft. from the fireclay mouthpieces. Another report mentions the cracking of the retort which occurred early in the initial heating up and developed with use. Two replies also mention the longitudinal expansion of the retort affecting the brickwork of the setting. In nearly all the above instances the blame has been laid on incorrect expansion cavities or to the incomplete burning away of the wood packing used.

All are unanimously of the opinion that a slow and progressive rise in temperature in the initial heating is essential to a long life in the setting for all types of retorts, but particularly for those made in siliceous and silica materials. As a precautionary measure to ensure even heating one management uses dry coke, free from damp breeze and smalls, and feeds only small quantities at a time, keeping the top of the fire red. Several replies emphasize the importance of adequate temperature recording apparatus. Some divergence of opinion is apparent regarding the critical temperature of siliceous and silica retorts. One reply considers that the makers' initial firing schedule plays for safety and in some instances could be shortened.

(*b*) *Vertical Retorts.*

Very little trouble is reported as being attributable to expansion stresses set up during the initial heating up or working of retorts of both these types, although reference is made to the occasional cracking of the top sections when too quick a rate of heating has been adopted. Two reports refer to the walls of the setting being affected, due to incorrect expansion allowances, and one other refers to trouble arising through leaks when undue expansion cavities were left.

It is generally agreed that great care should be taken to raise the temperature gradually when first putting the setting to work, and assuming sufficient care to be taken, the initial heating will have little influence in determining the life of the retorts.

Jointing Cements.

(*a*) *Horizontal Retorts.*

References are made to spasmodic instances where faulty joints due to unsuitable jointing material have been blamed for the failure of refractories. In one instance the joints were faulty through bad application of the cement rather than the behaviour of the cement itself.

The general practice appears to be to leave the selection of jointing material to the makers of the retort material, relying on their experience. Usually the composition of the cement follows closely on that of the refractories. Thin joints are generally recognized as being desirable, and the replies suggest that between $\frac{1}{16}$ in. and $\frac{1}{8}$ in. thicknesses are usual.

(*b*) *Vertical Retorts.*

In a number of instances the failure of refractories is attributed to the jointing cements. Although trouble with the jointing material fluxing is occasionally met with, it is more usual for the joint to fail through an insufficient adhesion to the brickwork.

Only by one undertaking is any definite specification made with regard to the composition of the silica jointing cement. This is a quartzite—2 per cent. lime—cellulose lye mixture, and the limits of the grading of the quartzite are stated. The remainder rely on the experience of the retort builders. Two observers object to the presence of sodium silicate in jointing cements. Another makes the observation that most jointing cements are contractile in nature, and for this reason afford a lodgment for coal and coke dust, the ash of which, liberated during scurfing, thenceforward acts corrosively.

About half the replies from plants of this type indicate little or no trouble with jointing material, the others have experienced deficiencies of one sort or another leading to leaks, and the necessity for hot patching after about a year's working. One plant is convinced of the necessity of having silica jointing material from the same locality as the refractories. Thin joints are considered to be the *sine quâ non* of successful retort building.

Hot Patching and Jointing Cements.

Work on hot patching of gas retorts by the application of dry powders has been continued. The present position of the investigation, however, does not admit of another report at this juncture.

As a result of the work on the use of wet plastic clay as a material for the hot patching of gas retorts it was found that the property of "stickability" was related more to the physical nature of the surfaces to be patched. The main requirements appeared to be

(1) a surface sufficiently rough for the plastic clay to "key" into the irregularities;

(2) sufficient plasticity in the clay for this to be achieved;

(3) sufficient strength in the suddenly heated clay for this initial adhesion to be maintained. It has not been found possible to relate "stickability" with any of the usual physical or chemical properties of the clays tested.

The investigations on jointing cements are continuing.

A convenient apparatus has been constructed for measuring the transverse strength of cemented joints both in the dried and fired states. It is proposed to compare the effects of additions of various reagents which confer workability and dry strength on cements.

Following the investigations on the permeability of refractory materials, factors influencing texture are receiving detailed study.

Work on the influence of different alkali salts on silica and fireclay products is proceeding. Experiments, concerning the action of potassium chloride in the presence of water vapour, have been commenced.

Experiments with a view to standardizing a refractoriness-under-load test are in progress. Two variables of the test, (1) the size of test-piece, (2) the loading, are under consideration.

During the past year a number of retorts have been examined for flaking, slagging, and other signs of trouble.

35th Report of the Joint Research Committee of the Institution and Leeds University

The Controlled Operation of a Carburetted Water Gas Plant—Part I. Factors Influencing the Performance of the Plant

Research Chemist: F. J. DENT, Ph.D.; *Research Assistants:* W. H. BLACKBURN, Ph.D., N. H. WILLIAMS, M.Sc.

The Report describes an investigation on which will be based a system of control for a carburetted water gas plant. The investigation consists of a study of how plant performance can be controlled through such factors as the rates of air and steam supplies, the relative durations of blow and run periods, &c. The system of control will be the subject of a further report.

The tests have been made on a Humphreys and Glasgow automatic, self-clinkering C.W.G. plant, and, within the limits of the investigation, have led to the following conclusions:—

On a particular plant, operated under given conditions of calorific value, blast pressure and quality of fuel, the cost of raw materials per therm C.W.G. is finally dependent upon the output obtained. The cost of raw materials increases with increase of output, and, except under peak load conditions, it is uneconomical to operate at maximum capacity.

The necessity for retaining in the blow gases sufficient heat for steam raising and oil cracking is a limiting consideration. The plant can be made self-supporting in steam, and only under certain circumstances detailed is it profitable to depend on steam from an external source.

Owing to incomplete admixture of blow gas and secondary air at the top of the carburettor, more heat had to be supplied for oil cracking than otherwise would have been necessary, and this restricted the performance of the generator. It is specially important to secure the most efficient utilization of the heat in the blow gases, an advantage already being obtained in plants erected subsequently to the one tested.

Modification of the depth of the fuel bed was the best means of preventing accidental variations in the quality of the fuel from affecting temperature conditions in the carburettor and superheater.

A higher thermal yield of B.W.G. per 1,000 lb. of coke and also a greater output can be obtained when using large coke. No mechanical difficulties arose, however, with smaller grades, and, under conditions in which the full output is not required, small coke can be used satisfactorily if its smaller monetary value compensates for the lower yield of blue water gas.

Excessive speed of rotation of the mechanical grate causes losses mainly because it reduces the proportion of the steam which can be supplied on the back-run. If the grate speed is reduced too far, however, the consequences of the accumulation of clinker nullify any savings thereby made, and, for this reason, the character of the ash in the fuel is very important in determining the performance of the generator.

The investigation showed that advantages can be secured by adapting operating conditions to the varying demands made from plants supplying either base or peak loads. It is believed that the results of the tests will be of assistance in making in practice the compromise between high output and low cost of raw materials, which, in conjunction with capital, maintenance, and labour charges, decides the economy of operation.

Examination Results of The Institution of Gas Engineers, 1934.

The Results do not include Candidates (a) *who withdrew before the Examination, or* (b) *who, having Second Class Certificates, re-sat and failed to secure First Class Certificates, or* (c) *whose Examination has not been completed.*

COMPARATIVE STATISTICAL SCHEDULE OF THE 1933 AND 1934 EXAMINATION RESULTS.

Examinations.	1933.					1934.				
	First Class with Distinction.	First Class.	Second Class.	Failed.	Total Sat.	First Class with Distinction.	First Class.	Second Class.	Failed.	Total Sat.
External—										
Diploma in Gas Engineering	..	3	10	3	16	..	3	4	2	9
H.G. Gas Engineering	..	5	12	4	21	1	8	12	8	29
O.G. Gas Engineering	..	3	12	16	31	1	10	17	20	48
O.G. Gas Engineering (single subject)	..	..	..	..	..	..	1	..	..	1
Diploma in Gas Engineering (Supply)	..	..	1	..	1	..	..	..	..	..
Diploma in Gas Supply	..	..	..	1	1	..	1	..	..	1
H.G. Gas Supply	..	5	3	1	9	..	3	4	8	15
O.G. Gas Supply	..	8	9	2	19	1	9	7	4	21
O.G. Gas Supply (single subject)	..	3	4	..	7	..	4	4	..	8
Internal—										
H.G. Gas Engineering	..	15	20	24	59	1	29	38	15	83
O.G. Gas Engineering	1	16	23	21	61	5	9	22	10	46
O.G. Gas Engineering (single subject)	..	3	3	..	6	1	2	2	..	5
H.G. Gas Supply	1	12	22	7	42	2	11	25	11	49
O.G. Gas Supply	9	35	46	16	106	8	24	54	19	105
O.G. Gas Supply (single subject)	4	23	11	..	38	4	10	10	1	25
Total	15	131	176	95	417	24	124	199	98	445

Modern Research Work and its Application in Practical Gas Supply

Presidential Address of F. C. Smith, F.C.S., Assoc.M.Inst.Gas E., of the Gas Light and Coke Company

London and Southern District Junior Gas Association, Oct. 19, 1934.

(*Continued from p. 277.*)

Effect of Products from Flueless Appliances.

Carbon dioxide and the accompanying oxygen deficiency as such are without physiological significance in environments with the smallest air change found in practice and under the most adverse conditions; but it has been thought that high CO_2 concentration and low oxygen percentage may lead to improper combustion of the gas in appliances satisfying the highest requirements in regard to combustion under normal conditions, and in consequence carbon monoxide may be produced in harmful quantity. This subject is under investigation at present at Watson House, and in general it may be said that combustion is in no way impaired until percentages of CO_2 are reached far above those likely to occur in any room in which the most elementary regard has been paid to the requirements of comfort conditions demanded by gas or any other fuel.

In general, the limitations placed upon an appliance by its environment are satisfied if reasonable comfort conditions are established and that air temperature takes charge long before the percentage of CO_2 can impair combustion.

The foregoing must not be construed into an advocacy for the indiscrimate use of flueless appliances, and the Industry must ever urge that well-flued appliances fixed in rooms provided with adequate air inlets are a very definite aid to promoting good ventilation. In this connection I would urge a greater study of at least the elements of the design of flue equipment. The combustion of the gas in first-class apparatus may be impaired if poorly designed and badly fitted flue equipment is used. It is pleasing to state that this subject is now well understood. Time will not permit a detailed discussion of this most important work, but work of C. A. Masterman and T. G. Noble[1] is well known in this connection. In life the dangers of the unknown are feared, but when matters are understood a reasoned confidence takes the place of an ignorant fear.

To-day the combustion of the gas in modern appliances, even at overload, is beyond reproach, and our competitors are welcome to any advantage they can secure from the full and frank statements made by the Industry in this connection.

Space Heating.

It is difficult to over-estimate the contribution of organized research to this problem so intimately associated with the health and wellbeing of every member of the community. The knowledge gained has, and I believe will continue to have, a great effect upon the theory and practice of heating and ventilating engineering.

In general, this work has been directed towards establishing—

(*a*) The general conditions necessary to promote the highest degree of human comfort in the home, the factory, public assembly halls, offices, &c.

(*b*) Criteria whereby comfort conditions can be specified and to provide means by which these conditions can be evaluated in terms of physical measurement entirely unaffected by the personal physiological response or the idiosyncrasies of a given subject or observer.

(*c*) The study of the heat requirements of and heat losses from buildings in the many and varied conditions which have to be met by the practical engineer.

The results have been woven into mathematical expression, the application of which should do much to elevate the technique of heating and ventilating engineering from a matter of experience (invaluable as experience undoubtedly is) to the more precise and sound basis of organized knowledge.

In moving towards this end, research workers have determined and tabulated for easy reference the thermal characteristics of practically all the materials used in modern building operations, and have been able to give a valuable lead as to the conditions under which these materials may be used to the best advantage in building construction.

(*d*) Workers more directly associated with the practice of heating and ventilating engineering have been able to improve the performance of plant, and the efficiency of heating appliances in common use. Appliances and regulating gear incorporating sound engineering practice, designed with due regard to economic requirements, have been developed which are suitable to promote the comfort conditions prescribed by the more detached scientific workers.

In general, the work referred to under headings (*a*), (*b*), and (*c*) has been carried out in this country by such bodies as the Department of Scientific and Industrial Research, the Medical Research Council, and by members of the Heating and Ventilating Engineers; in America, in the laboratory of the U.S. Bureau of Mines under the auspices of the American Society of Heating and Ventilating Engineers.

I have already stated that the results of these and similar investigations have had a tremendous effect upon practice, and I would add that the Gas Industry cannot afford to be in ignorance of these activities or fail to allow the well-established findings of such bodies to influence our developments in this sphere, even should it mean departure in certain directions from accepted practice.

It is impossible to do more than indicate how investigation has changed the focus of our ideas in regard to the practice of heating and ventilating engineering. A few years ago the heating and ventilating engineers' only criterion of a satisfactory installation was the dry bulb temperature, and conditions were regarded as satisfactory if the temperature of the air was maintained reasonably constant about a temperature of 60° F. (in this country).

Modern work has indicated that " comfort " can only be secured by promoting conditions which regulate the rate of heat loss, and the method by which heat is lost, from the human body within well-defined limits and that air temperature is only one factor affecting these considerations.

General Considerations Affecting Comfort Conditions.

Rate of Heat Loss from the Human Body.

Physiologists have indicated that the rate of heat loss from the human body by convection and radiation is the factor which largely determines whether or no a given enclosure is comfortable.

In passing, it may be well to remind you that the Home Office Regulations controlling conditions in factories still have a clause which demands that the carbon dioxide concentration in the air shall not exceed 12 parts per 10,000 when artificial lighting is not in use and 20 parts per 10,000 during the period of artificial lighting.

This clause can be aptly described as unfortunate, since it has given rise to two major misunderstandings. In the first case, it has led persons quite well informed in many other directions to conclude that carbon dioxide is a poisonous gas, and, secondly, to think that providing the conditions laid down in the Regulations are complied with that all is well, and the factory is a healthy and comfortable (used in the sense referred to in this paper) place to work in. It should be added that the same Regulations stipulate requirements in regard to air temperature.

In the first case, it has been established beyond question that carbon dioxide, as such, is not a poisonous gas, and in concentrations 10-20 times above the limits set out is entirely without physiological significance; moreover, the Regulations may be complied with to the letter and

[1] Gas Fires, Flues, and Ventilation. C. A. Masterman, T. G. Noble, Communication 80, Inst. of Gas Engineers.

Combustion, Wind, and Flue Equipment. C. A. Masterman, Proc. Inst. of Heating and Ventilating Engineers, Vol. XXXVIII., 1930.

yet conditions may be very far from happy—in fact, may be definitely unhealthy.

It must not be concluded, however, that the determination of carbon dioxide in the air is entirely valueless as this figure may be used under certain conditions by a skilled observer to assess the ventilation qualities of the premises in question. Air change is one factor influencing comfort conditions, but this must be compounded with several others in assessing these conditions. Again, assuming the carbon dioxide is entirely of human origin, it may be regarded as some sort of easily determined indication of bacteriological contamination. Unfortunately, however, a perfectly good heating installation could be condemned by a too rigid application of this regulation, and a thoroughly bad installation permitted to remain.

There is nothing mysterious about the factors influencing the rate of heat loss from the human body. They are similar to those affecting the heat loss from any other body, with one exception, that only in certain cases in general problems of heat loss is it necessary to consider the heat loss by evaporation from the surface of the body in question.

In general, the losses by convection and radiation at a surface losing heat freely in air are governed by the temperature difference between the hot body and its surroundings, the temperature and rate of movement of the air passing over the surface, and the emissivity of any surfaces taking part in the radiation exchanges. The relative proportions of heat loss by radiation and convection are also controlled by these factors.

These factors, together with evaporation losses so closely associated with air movement and humidity are the factors which influence the rate of heat loss from the human body, and ultimately are the influences which control comfort conditions.

Some Relevant Facts about the Human Body.

(1) The temperature of the blood of a person in normal health is about 98·4° F., and this temperature is maintained almost constant by a most perfect thermostatic device. Since the temperature of the surroundings is under normal conditions many degrees below this figure it is evident that appreciable heat losses occur to the environment.

(2) The average temperature of the skin of a clothed human body in this country has been computed by Dufton to be on a rough average of the order of 75° F.

In America according to the observations of Alldrich (Smithsonian Miscellaneous Collections, December, 1928, 81) the mean temperature of the skin and clothing is 83° F. (about).

The reason for this variation may be a little obscure, but two facts are probably of importance in this connection:

(1) The air temperature and humidity are in general higher than in this country and the standard of comfort is at a higher air temperature.
(2) The thermal characteristics of the clothes worn may differ.

It has been computed[1] that in general, under conditions of comfort for sedentary workers, heat is lost in the following proportions:

(*a*) By radiation, 50%.
(*b*) By convection, 33%.
(*c*) By evaporation of moisture from the lungs and skin, 20%.

If the environment conditions are changed in such a way as to ensure the same rate of heat loss from the body the amount of heat lost by radiation may be increased; it follows that the amount lost by convection and evaporation in our example will be decreased. It by no means follows, however, that the same degree of comfort is experienced.

This suggests that not only is the rate of heat loss important but the manner in which the heat loss takes place is also of significance. For example, suppose a subject to be losing heat at a definite rate in a room of air temperature 60° F., and humidity 65%, and that reasonable air movement is experienced. Under such conditions, the subject will probably be comfortable. Now suppose the same subject to be in the same room but now the air temperature is 75° F., and the air movement to be restricted. It is probable that the rate of heat loss from the subject will be of the same order in each case, but the losses by radiation and convection will be reduced. It follows, therefore, that the losses by evaporation from the skin and the lungs will be increased, and it is a matter of common experience to know that such a condition promotes parched lips, dry throat, &c. Such a condition is uncomfortable.

The heat losses from the body must take place in such a manner that the correct proportionality is preserved between the various methods by which heat is lost if ideal comfort conditions are to be experienced.

It should be appreciated clearly that conditions which are comfortable for a given class of work (a given amount of physical exertion) are not the optimum conditions if work involving a very different degree of physical exertion is to be undertaken. The above figures are for sedentary workers. Sweating and closing of the pores of the skin can be regarded as emergency operations only and lead to discomfort.

Correlation of Physiological Response with Conditions as Determined by Physical Measurement.

In this lies the inherent difficulty in this class of work. It is possible to determine with a high degree of precision the air temperature, humidity, &c., of an environment, and to measure air velocity in the environment with accuracy. All these factors, as we have seen, are of the greatest importance to the wellbeing of the subject in the environment, but none of these as such can give an index to comfort. What is required is an instrument which is able to compound these various factors, and give a scale of comfort which is related in a very definite manner to the physiological response of the subject to the environment. The matter is complicated further by the fact that the physiological response of various subjects to a given environment is not the same.

A somewhat similar difficulty is met with in photometric determinations. Fundamentally in photometric measurement one is asked to compare visually the brightness of two surfaces which may be illuminated by two sources of light having differing distributions of energy in the visible spectrum. If, for instance, two surfaces of a similar nature in juxtaposition each receiving the same flux of monochromatic light but of differing wave lengths, are to be compared, the brightness of one surface will be greater than the brightness of the other, but two competent observers would in all probability get differing results because their individual response to light of various wave lengths is not the same.

In order to determine what are known as the international visibility factors for various wave lengths, observations were made by hundreds of observers, the results were plotted, and a curve drawn through the plottings. The results so obtained are the visibility factors for the average eye. It will be seen that the term " average eye " has a very definite technical meaning.

This is just another illustration of the fact that measurement dependent upon physiological response cannot be so precise as other forms of measurement with which science is familiar. This, however, does not mean that such measurements are useless; indeed, in many cases they are the only type providing a criterion to the facts under review.

In the case under review, these facts mean that very many observations must be made upon many subjects under many and varied conditions in order to arrive at the average physiological response of the human body to the various environments, and that an instrument which purports to give an index to comfort conditions must react to the various environments in a similar manner to the average subject. Much work has been done to accomplish this end, and it is to this work that I would ask your attention for a few moments.

The Kata Thermometer.

As long ago as 1919, the Medical Research Council issued a report under the authorship of Dr. (now Sir) Leonard Hill, in which it was claimed that the loss of heat from the human body is dependent upon the cooling power of the air. Moreover, it was maintained that the temperature of the air (as determined by the dry bulb thermometer) was of secondary importance as compared with its movement. As a consequence, Sir Leonard Hill constructed an instrument, known as the Kata Thermometer, for measuring the cooling power of the air. A figure which represents the rate of heat loss from the thermometer in millicalories per sq. cm. per sec. under given comfort conditions is obtained readily by observing the time in seconds for the temperature of the Kata to fall from 100° F. to 95° F. and dividing a figure characteristic of each thermometer, which is engraved on the stem, by the time expressed in seconds taken for the observation.

The following figures, abstracted from " Principles of Heating and Ventilation," support Sir Leonard Hill's con-

[1] Principles of Heating and Ventilation, 1934, H. M. Vernon.

tention as to the important influence of air movement upon the rate of heat loss from the instrument:

Conditions.	Temp. of Air.	Velocity of Air. Ft. per Min.	Cooling Time of Kata. Secs.	Cooling Power of Kata.
Constant temperature, variable air velocity	65°	12	88	5·3
	65°	30	74	6·4
	65°	100	54	8·7
Variable temperature, constant air velocity	55°	30	56	8·4
	75°	30	107	4·4

It is interesting to note in passing that the Kata Thermometer can also be used to determine air velocity.

The Significance of the Kata.

It should be appreciated clearly that the figures for cooling power as obtained by this instrument represent the rate of heat loss from this thermometer, and are not directly a measure of the rate of heat loss from the human body. The readings obtained from the instrument have been correlated, however, with the experience of a very large number of subjects under various environment conditions, the subjects performing manual work of practically all representative types. As[1] a result, it is now possible to say that for definite classes of occupation the conditions are comfortable, if the figure for the cooling power of the instrument in the particular environment is between a certain limited range.

The Wet Kata.

Since some 20% of the total heat loss from the body is by evaporation it is evident that the humidity of the environment must affect the rate of heat loss from this cause. The humidity of the environment has but little effect upon the rate of cooling of the dry Kata.

Sir Leonard Hill introduced the Wet Kata in order to take into account the effect of humidity. This instrument is similar in all respects to the dry Kata except that a detachable silk stocking is provided which stretches snugly over the bulb of the instrument. The instrument thus covered is placed into warm water at about 102° F., then removed from the water, and the time in seconds for temperature of the instrument to fall from 100° F. to 95° F. is determined.

The rate of cooling is then calculated by dividing the characteristic figure for the particular instrument by the time in seconds as determined for the particular environment. Since evaporation is taking place rapidly under these conditions, the rate of heat loss is increased by an amount very closely related to the humidity, although the velocity of the air passing over the bulb and the temperature of the environment are contributory factors.

Although the results obtained can be correlated with the physiological response, there can be little doubt that the wet Kata over-emphasizes the importance of humidity upon the cooling power of the air. The fraction of cooling power due to evaporation is much greater with the wet Kata than that experienced by the human body under most circumstances.

It has been stated that the normal changes in humidity experienced in this country have little effect upon comfort conditions; in countries where climatic conditions are dissimilar to our own, humidity assumes greater importance.

Effective Temperature.

F. C. Houghton (Director of the Research Laboratory of the American Society of Heating and Ventilating Engineers) summarizes the results of many years of patient investigation in these words: "An ordinary thermometer is only of relative value for indicating a person's feeling of comfort as the sense of warmth experienced by the human body is not due alone to the temperature registered by the dry bulb thermometer, neither does it depend solely upon the wet bulb temperature. Dry air at a relatively high temperature may feel cooler than air of considerably lower temperature with high moisture content.

"There are three principal factors affecting loss of body heat:

(1) Temperature, (2) Humidity, (3) Air motion.

"As the temperature of the air and surrounding objects rises, the loss of heat by convection and radiation decreases. When the air temperature reaches that of the body, the loss by radiation and convection ceases. Finally, as the air temperature exceeds that of the body, heat passes from the air to the body. If, on the other hand, the relative humidity is increased the heat loss by evaporation decreases. If, while the dry bulb temperature increases the wet bulb temperature decreases sufficiently, the increase in loss of heat by evaporation may be made equal to the decrease in loss of heat by radiation and convection, resulting in no change in body temperature or comfort.

"From the above it is concluded that there must necessarily exist certain combinations of temperatures and humidities which produce the same total heat loss by radiation, convection, and evaporation, and therefore the same feeling of comfort or discomfort."

Lines passing through such air conditions plotted as a psychrometric chart may be called equal comfort lines.

A great deal of work has been carried out in the Laboratory referred to in order to locate these lines for conditions of still and moving air.

Fig. 6 is a reproduction of one of these psychrometric charts for still air conditions. In this chart dry bulb temperatures have been plotted as abscissæ, and grains of water vapour per lb. as ordinates. The wet bulb temperatures for all atmospheric conditions are given by a series of nearly parallel oblique lines. On the chart will be found a series of oblique, but not parallel, lines which are referred to as "effective temperature" lines.

As already indicated, even for still air conditions, the dry bulb temperature does not in itself indicate a person's feeling of warmth, at the same dry bulb temperature a person will feel warmer or colder in accordance with whether the wet bulb temperature is higher or lower. Again, wet bulb temperature is the temperature that a thoroughly wet body will attain if air passes over it for a sufficient time at a sufficient velocity. At high air temperature when the body is wet with perspiration it reacts more nearly to the wet bulb temperature, whereas at low temperature when the body is comparatively dry, the reaction is more nearly in accordance with dry bulb temperature.

Effective temperature is defined as an experimentally determined scale, which is a true measure of, or index to, a person's feeling of warmth in all conditions of temperature and humidity. This definition implies that with any given effective temperature a person will feel the same degree of warmth or coldness regardless of the dry bulb or wet bulb temperatures.

It has been determined experimentally that for persons wearing normal clothes 97% of all persons are comfortable at an effective temperature of 64° in still air. In consequence, 64° effective temperature has been called the "comfort line." In addition, 50% of persons are said to be comfortable in a zone of effective temperatures ranging from 62°-69° effective temperature. This range is referred to as the "comfort zone."

In practice, the air is seldom still, and, as air movement is known to have an important bearing upon comfort conditions, this factor must be taken into account if the proposed scale of effective temperature is to be useful. In this connection, tables are available giving effective temperatures for various wet and dry bulb conditions and taking into account various velocities of air movement.

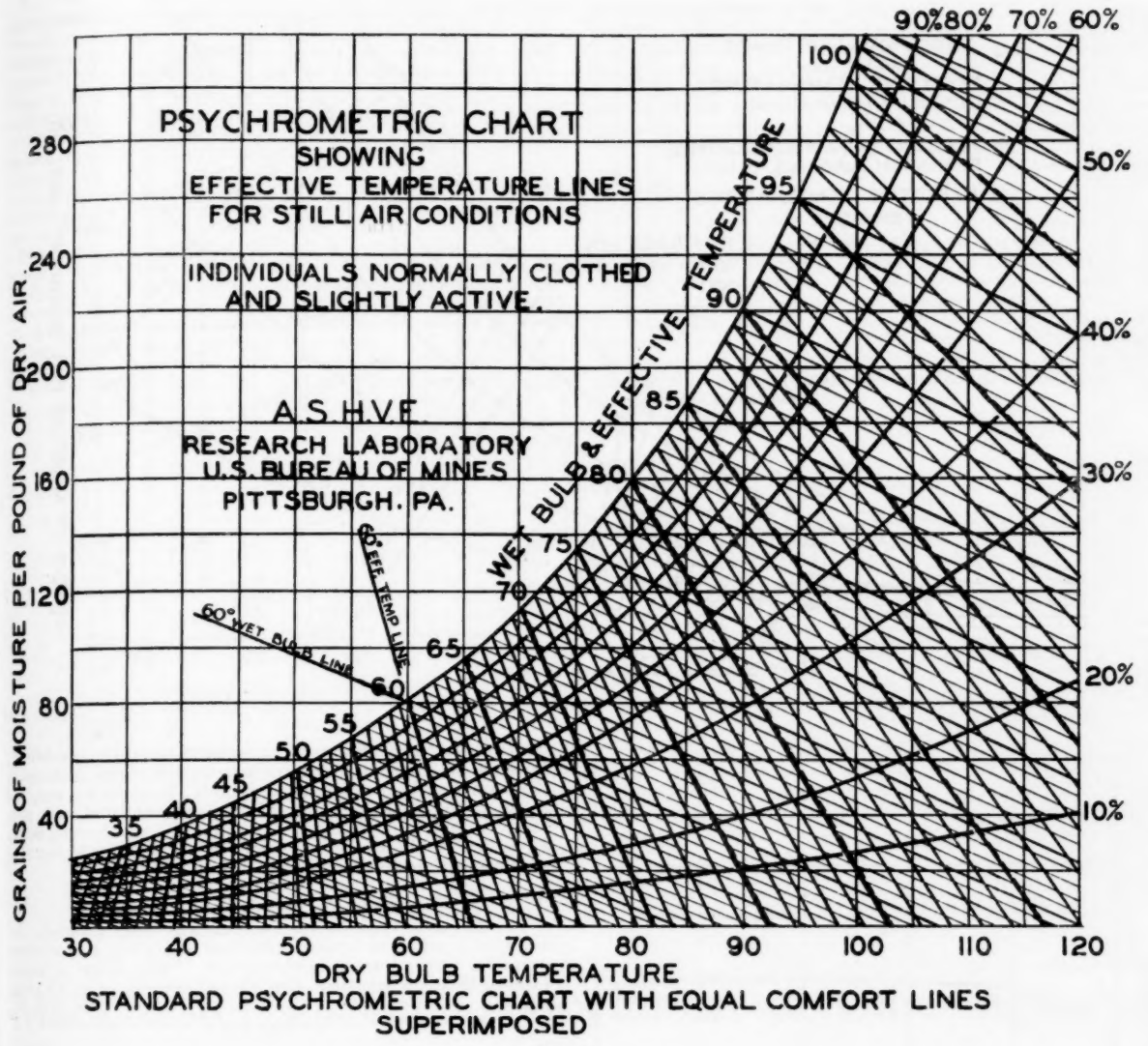
Fig. 7 is a chart in skeleton form (see "Mechanical Equipment of Buildings," Harding & Willard, Vol. I., page 476) which combines all these effects. In any one bracket a person's sensation of comfort along any one of the effective temperature lines is exactly the same as for still air effective temperature line at the bottom of the bracket in question.

In America the effective temperature scale is the basis for assessing comfort conditions, and it has the merit that this temperature can be assessed provided the wet and dry bulb temperatures, and air velocity, can be determined. It does not, therefore, demand the purchase of costly special apparatus, but may be determined by apparatus commonly possessed by any reasonably equipped laboratory. It is not the purpose of this address to examine critically the relative merits of the dry Kata cooling power and the effective temperature scale as an index to true comfort conditions; but it may be as well to state in passing that some investigators have criticized the effective temperature scale when taking into account air movement, and have regarded the dry Kata cooling power as the better indication.

It is now important to refer to the most recent work that has been done in this connection, as a result of which a special instrument has been designed for assessing comfort conditions.

It will be remembered that some 50% of the total heat loss from the human body is by radiation, and it is apparent that neither the Kata thermometer nor the instruments required to determine effective temperature are

[1] Balham, Assheton, and Raynes. H.E. Report of Director General of Public Health, N S.W., 1926.
Vernon, Bedford, and Warner Report 100, 1926. Med. Res. Council.
Vernon, Bedford, and Warner Report 35. Industrial Fatigue Res. Board, 1926.



STANDARD PSYCHROMETRIC CHART WITH EQUAL COMFORT LINES SUPERIMPOSED

FIG. 6.

adequate for assessing the heat loss by radiation to surrounding solid bodies. The temperature and emissivity of the surrounding surfaces must have a very important effect on the radiation exchanges, and the instruments referred to above are peculiarly unsuitable for this purpose, especially because the small size of the instruments magnifies the relative effect of radiation as compared with convection losses. Moreover, the growing popularity of low-temperature radiating panels, to say nothing of high-temperature sources of radiation, render it more and more necessary to take into account the radiation exchanges referred to.

H. M. Vernon states: "It is customary to ignore the factor of radiation when persons are occupying a room when the air and walls are at the same uniform temperature, but this is an error, and one which is likely to be rectified in the near future. We are now realizing how important radiation effects are in all questions of heating."

Two new instruments are now available which take into account these effects.

The Eupatheoscope.[1]

The eupatheoscope is a black-painted hollow cylinder 22 in. in height. The cylinder is thermostatically controlled so that the temperature of its radiating surface is maintained constant at 75° F. (the temperature of the clothed human body). The amount of heat necessary to maintain the surface temperature of the instrument is determined by the air temperature, air movement, and the radiating conditions of surfaces in proximity to the instrument.

Since the temperature of the surface of the eupatheoscope is maintained constant the heating value of the current per unit of time, used for this purpose, must be a measure of the rate of heat loss from the instrument.

In England the normal standard of comfort is attained if the instrument loses heat at the rate of 17·5 B.Th.U. per sq.ft. per hour. In still air this condition is obtained if the walls and surrounding air temperature are at a temperature of 64·3° F.

In America, since the average temperature of the clothing and skin is computed to be 83°, the eupatheoscope was arranged to maintain a surface temperature of 83° F. In still air at 72·3° F., with the surrounding surfaces at a like temperature, the instrument loses heat at the rate of 15·4 B.Th.U. per sq.ft. per hour. The variation between American and English conditions has already been referred to.

Suppose the eupatheoscope to be set up in a room in which surrounding surfaces are at a higher temperature than the mean air temperature, the rate of heat loss from the instrument is diminished, or what is known as the equivalent temperature of the environment is increased. By a very ingenious arrangement, a thermometer relates the rate of heat loss from the instrument to the equivalent temperature. The higher the rate of heat loss, the lower the equivalent temperature and *vice versa*. The equivalent temperature may be read off the thermometer scale attached to the instrument, or the instrument may be connected to a recorder, and a continuous record of equivalent temperatures for the room in question be obtained.

Equivalent temperature of an environment may be defined as that temperature of a uniform enclosure in which in still air a sizable black body at 75° F. would still lose heat at the same rate as in the environment.

The eupatheoscope may now be regarded as the standard

[1] Dufton, A. F. Phil. Mag., 1930, 9, p. 858.
Dufton, A. F., and Fishenden, M. Proc. Inst. Heat. and Vent. Eng., 1929, 28, p. 98.
Dufton, A. F. J. Inst. Heat. and Vent. Eng., 1933, 1, p. 99.

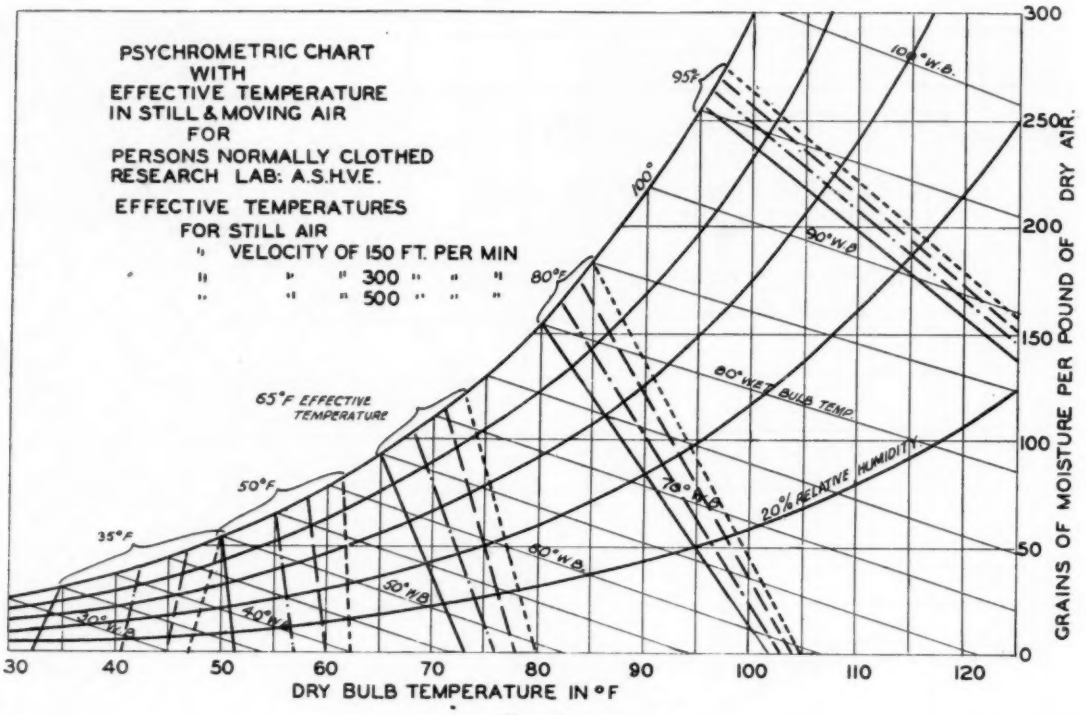


FIG. 7.

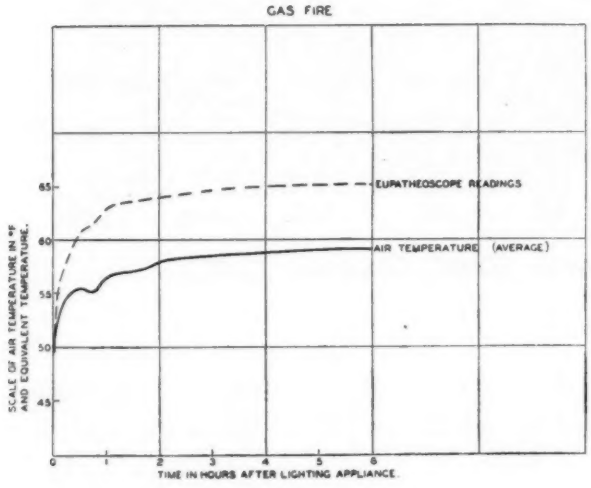

GAS FIRE
EUPATHEOSCOPE READINGS
AIR TEMPERATURE (AVERAGE)
SCALE OF AIR TEMPERATURE IN °F AND EQUIVALENT TEMPERATURE.
TIME IN HOURS AFTER LIGHTING APPLIANCE.

FIG. 8.

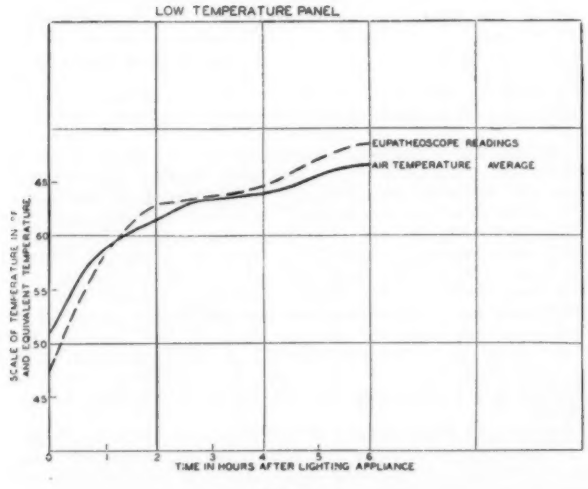

LOW TEMPERATURE PANEL
EUPATHEOSCOPE READINGS
AIR TEMPERATURE AVERAGE
SCALE OF TEMPERATURE IN °F AND EQUIVALENT TEMPERATURE
TIME IN HOURS AFTER LIGHTING APPLIANCE

FIG. 9.

instrument in England for assessing comfort conditions. It must be realized that this instrument above behaves in the same manner as a human body, heat being supplied to keep the surface temperature constant, and also it is large enough to be sensibly the same size as a human body. It makes no allowance, however, for the change in the rate of evaporation due to changes in humidity, &c.

Globe Thermometer.[1]

Yet another type of instrument has been proposed for measuring what is termed effectual radiation temperature or globe thermometer temperature. The value of ascertaining this temperature depends, of course, as do all these

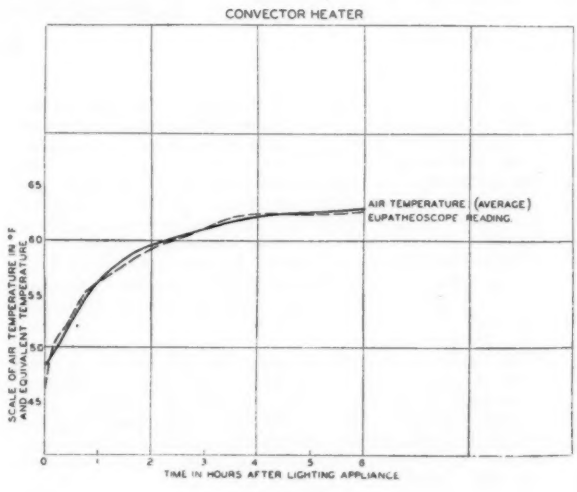

CONVECTOR HEATER
AIR TEMPERATURE (AVERAGE)
EUPATHEOSCOPE READING.
SCALE OF AIR TEMPERATURE IN °F AND EQUIVALENT TEMPERATURE
TIME IN HOURS AFTER LIGHTING APPLIANCE

FIG. 10.

methods, on the accuracy with which it can be correlated with the warming effect on the human body.

It is common knowledge that if two similar mercury in glass thermometers be exposed to a source of thermal radiation, and the bulb of one is blackened, this thermometer will indicate a higher temperature than the instrument with the silvered bulb. It is also apparent if the surface area of the blackened bulb be increased, the temperature recorded by such a thermometer will be correspondingly higher.

It has been found that a blackened copper bulb of 6 in.

[1] Vernon, H. M. J. Phys., 1930, 70, p. XX.
Proc. Inst. Heat. and Vent. Eng., 1932, 31, p. 160.

diameter with an ordinary thermometer at the centre constituting what one might call an " outsize " in black bulb thermometers records approximately the maximum temperature obtainable when placed at a distance of some 6 ft. from a source of radiation such as a gas fire, and that under these conditions a further increase in the diameter of the thermometer makes but little difference to the recorded temperature. Suppose, in still air, such a thermometer be exposed in a room in a suitable way to such a source of radiation, and that an ordinary thermometer with the bulb protected from direct radiation be placed at the side of this instrument, then the ordinary thermometer will register a temperature which is a very close approximation to the true air temperature, while the blackened thermometer will indicate a temperature considerably in excess of the latter, the excess temperature being related to the radiation incident upon the blackened bulb. Now suppose conditions in the room to change and an air current to move across the bulbs of both thermometers, then it will be found that the temperature recorded by the ordinary thermometer is scarcely changed but the temperature recorded by the globe thermometer will fall very rapidly at first, and finally become almost stationary at a temperature several degrees below the original temperature recorded by the instrument.

If the difference in reading between the two thermometers be referred to as the effectual radiation temperature, it will be observed that this temperature is much reduced when air movement is taking place.

The figures in the table below are reproduced from " Principles of Heating and Ventilation," by H. M. Vernon, p. 23, and illustrate the phenomena.

H. M. Vernon says " From these and other observations it follows that the effectual radiation temperature is influenced by a number of factors such as air movement, the quality of the surface radiated upon, and possibly the quality of the radiation," and he further adds, " The mere fact that the radiation from a given source is found by means of a bolometer or radiometer, to attain a certain magnitude, does not tell us what heating effect will be produced in a globe thermometer, and it is this effect that we desire to ascertain."

Diameter of Globe.	Globe Material.	Globe Covering.	Gas Fire.				Anthracite Stove.			
			Still Air Temperature.		Moving Air Temperature.		Still Air Temperature.		Moving Air Temperature.	
			Globe Cloth Covered.	Globe Painted Black.	Globe Cloth Covered.	Globe Painted Black.	Globe Cloth Covered.	Globe Painted Black.	Globe Covered Cloth.	Globe Painted Black.
In.			°F.	°F.	% of Still Air Temperature.	% of Still Air Temperature.	°F.	°F.	% of Still Air Temperature.	% of Still Air Temperature.
9	Pasteboard	Dark cloth or black paint	12·3	11·5	54	44	4·9	5·0	39	37
6	,,	,, ,, ,,	12·1	11·1	51 } 49	42 } 43	4·6	4·7	40 } 36	34 } 34
2·5	Glass	,, ,, ,,	11·3	10·3	47	45	4·3	4·2	30	31
0·3	,,	,, ,, ,,	7·9	6·1	46	41	3·4	3·0	34	34
6	Pasteboard	White linen	10·4	..	49	..	4·7	..	39	..
6	Glass	Black paint	..	12·3	..	44	..	5·0	..	32
6	Copper	,,	..	12·5	..	45	..	..	..	..

(To be continued.)

Manchester District Association of Gas Engineers

The Ordinary General Meeting of the Manchester District Association of Gas Engineers was held at the Midland Hotel, Manchester, on Friday, Oct. 26—Mr. F. G. SHAW (Buxton) presiding. There were about 130 members and guests present.

Mr. H. Vernon (Nantwich) and Mr. J. H. Law (Marple) were appointed scrutineers of the ballot papers for the election of the Officers of the Association.

The Committee's payment of £21 to the Sir Arthur Duckham Memorial Fund was unanimously approved.

New Members.

The following were inducted as members of the Association:

Mr. Charles Bateman (Engineer and Manager, Harrogate); Mr. R. H. Clayton, M.Sc. (Director, Manchester Oxide Company, Manchester); Mr. R. L. Greaves (Assistant Engineer and Manager, Stockport); and Mr. W. P. Smith, B.Sc. (Engineer and Manager, Fleetwood).

Presentation of Examination Certificates.

The PRESIDENT presented certificates to a number of candidates who had been successful in examinations. The complete list of candidates who had gained certificates is as follows:

Higher Grade Gas Engineering (External Candidates).

C. R. Corrin	Onchan, I.O.M.	1st Class
P. R. Dawson	Kendal	,,
R. W. Foulds	Southport	,,
R. B. Garside	Morecambe	,,
F. H. Jolly	Wrea Green	,,
V. J. J. Siddons	Barnsley	,,
H. Burnet	Preston	2nd Class
E. Corris	Morecambe	,,
J. Royston	Kildwick	,,
W. Walker	Lytham	,,

Higher Grade Gas Supply (External Candidates).

A. J. Leather	Blackburn	1st Class
J. A. Derbyshire	Darwen	2nd Class
F. B. Halliwell	Rotherham	,,

Higher Grade Gas Engineering (Internal Candidates).

J. Clough	Clayton-le-Moors	1st Class
A. Field	Hellifield	,,
E. B. Field	Blackburn	,,
D. A. Foster	Newton Heath	,,
G. Haslam	Bolton	,,
T. Hayes	Farnley	,,
C. W. Hemingway	Purston	,,
N. Henderson	Eccles	,,
R. Hutchinson	Worksop	,,
F. H. King	Rochdale	,,
C. B. S. Mitchell	Newton Heath	,,
A. Pickard	Knottingley	,,
W. Rhodes	Bingley	,,
W. Blackburn	Glossop	2nd Class
H. Curry	Blackpool	,,
H. Firth	Halifax	,,
W. T. Hainsworth	Armley, Leeds	,,
C. U. Jessop	Sheffield	,,
M. Newsome	Chorley	,,
J. Richardson	Handsworth	,,
A. Robinson	Morley	,,
E. R. Stewart	Nelson	,,
G. Turner	Liverpool	,,
J. H. S. Williams	Altrincham	,,
J. A. Woodcock	Newton Heath	,,
R. E. Parsons	Warrington	,,

Higher Grade Gas Supply (Internal Candidates).

R. Boothroyd	Huddersfield	1st Class
R. Howarth	Cleckheaton	,,
J. K. Mitchell	Hipperholme	,,
F. Dawson	Huddersfield	2nd Class
H. Raistrick	Bradford	,,
N. Rhodes	Bradford	,,
F. Roberts	Bradford	,,
K. H. Tyndall	Huddersfield	,,
R. H. Webster	Huddersfield	,,
H. Whitehead	Huddersfield	,,

Diploma in Gas Engineering (Manufacture).

To be presented at the Autumn Conference of the Institution of Gas Engineers:—

J. B. Walsh	Altrincham	2nd Class

The new President and retiring President—Mr. A. L. Jennings (Spenborough) and Mr. F. G. Shaw (Buxton).

A paper entitled "The Utilization of Town Gas in Industrial Heat Application," by Mr. G. H. Windiate and Mr. E. B. Craddock (Stretford) was read by the last-mentioned author. The paper, together with a report of the discussion, will be found on later pages.

Election of Officers.

The election of the following officers for the ensuing year was announced:

President.—A. L. Jennings (Spenborough).

Senior Vice-President.—A. L. Holton (Manchester).

Junior Vice-President.—R. N. Webb (Leeds).

Hon. Secretary.—J. Bridge (Elland).

Auditors.—R. B. Braddock (Radcliffe) and F. Elliott (Leyland).

Three vacancies on the Committee were filled by the election of Messrs. H. Curtis (Macclesfield), J. T. Haynes (Rotherham), and T. Reynolds (Stockport).

Mr. A. L. Jennings acknowledged the honour which had been accorded to him by his election as President of the Association, and said that he hoped to be able to follow worthily in the footsteps of the many able Presidents who had gone before.

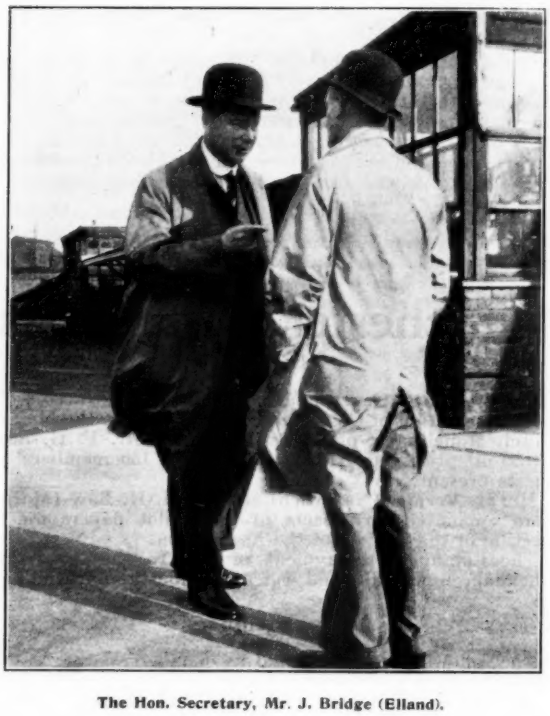
Visit to Old Trafford.

In the afternoon about 120 members and friends travelled to Old Trafford and observed the large-scale applications of town gas to industrial purposes which had been described in the paper. At the cable works of Messrs. W. T. Glover & Co. they were received by Mr. W. T. Anderson. Mr. Shaw, on behalf of the visitors, thanked the firm for giving them the opportunity of seeing these important demonstrations of the industrial use of gas.

About an hour was occupied at these works, and the visitors were then conveyed to the Ingersoll-Rand Company, Ltd. Several gas-fired furnaces and other features of interest were examined here.

Tea was provided in the Trafford Public Hall, by the Stretford and District Gas Board, and they were welcomed by Councillor D. Jones, deputizing for the Chairman of the Board. He said he believed what they had seen that afternoon must have made a great impression on their minds. Even to him it was very interesting, and he thought the firms were to be congratulated upon the enterprise they had shown. He and his colleagues on the Board wished all future prosperity to the Industry.

Mr. G. Dixon (Nottingham) proposed a vote of thanks to the Chairman and members of the Stretford and District Gas Board and to Col. W. M. Carr. He said the Board were always willing to give to others information acquired in their own experience, and the thanks due to them could not be sufficiently expressed by any formal vote. But



The Hon. Secretary, Mr. J. Bridge (Elland).

proof that it was gratefully appreciated was given by the way in which the members had availed themselves of this opportunity to see the progress that was being made in the industrial application of gas. They felt they were on the threshold of a very big future, and they were all exceedingly keen and anxious to get as much information as possible on the subject. Among industrialists in this country there was a demand for gas which could only be adequately met by pooling knowledge.

Mr. R. N. Webb (Leeds) seconded the vote of thanks.

Col. Carr said he had the support of a staff as enthusiastic as himself and he was glad that two of them had been given the opportunity to present the paper. He was sure it would encourage them to further efforts. It was also his sincere hope that there would be increasing co-operation between all in securing industrial loads for the Gas Industry.

The Application of Town Gas to Industrial Heating Problems*

By G. H. F. Windiate and E. B. Craddock, of the Stretford and District Gas Board

The application of town gas to industrial heating has occupied the minds of the Gas Industry to a limited extent for the past few years, but it is apparent that more and more attention must be given to the economics of the supply of large gas loads at special rates.

It is not proposed to discuss the pros and cons of the practice of making contracts at special prices for special loads—at Stretford the results have justified the means—but it is as well to point out that we at Stretford are admirably placed in that practically all the large users of gas are centralized in the industrial area at Trafford Park. Two compressors supply gas at a pressure of 4 lbs. per sq. in., via two steel mains to six distinct governors situated in the Park, and it will be appreciated that the capital charges on such a system are considerably less than upon a system serving large consumers who are distributed over a wide area in and among residential districts of very much smaller consumers.

The actual area covered by Trafford Park is 1,180 acres, of which about two-thirds are developed, and the total gas consumption for the immediate past twelve months was 226,192,600 c.ft., equivalent to an annual gas consumption of 190,000 c.ft. (approx.) per acre. Expressed as consumption per mile of main, the figure is 16,385,900 c.ft. From these figures it will be appreciated that standing supply charges per consumer are reduced to a very small figure.

Three years ago, when the Ford Motor Company moved from Trafford Park to their new Works at Dagenham, we lost a load of 114,038,000 c.ft. per annum. Since that time we have added 115,206,300 c.ft. per annum of new load, but that increase has not been obtained merely because we are able to manufacture and sell cheap gas.

Cost per Unit of Product.

The manufacturer or gas consumer is not directly concerned with the price of gas or any other fuel, but primarily with the cost per unit of his product. It is not intended to imply that he will not be tempted to buy a fuel which looks cheap, in first cost, and he is often deceived by fuel costs per ton, per gallon, and per therm, particularly when they are compared on the basis of thermal value without reference to efficiency in application; and it is the gas undertaking's duty to provide enlightenment on this point, which involves a close knowledge of manufacturing processes followed by careful investigation as to the most efficient appliance for a particular job of work.

This enlightenment, or one might even say education, is a part of the service to be rendered to all actual and potential consumers. Our method at Stretford of maintaining contact with our industrial market is to visit all manufacturers, whether consumers or not, two or three times a year. These visits afford an opportunity for the undertaking to acquaint the manufacturer with the latest types of gas-fired furnace in his particular line and an opportunity for the building up of mutual confidence, which must exist as a foundation for continuous and progressive business.

It is as a result of such service calls that most of the new business has been developed. As an illustration, we are present dealing with a live inquiry for heat treatment furnaces for a particular manufacturer which is the result of years of service calls and mutual help, and we believe that but for the contact maintained over this long period we should have received but scant consideration, and oil and coal would have continued in use.

When an inquiry is obtained, too much stress cannot be laid upon the necessity of the collection of all possible data upon past and present practice of heating, of material handling, of special processing, and of quality of the final product. Here the Industrial Gas Centres can be of the utmost use. The great pool of information, rapidly widening as it is, which is available in this organization, covers, or will cover, practically every heating operation in which gas or any other fuel is used.

Following upon the collection of data from every possible source, we make a careful analysis and investigation before submitting any new proposals, which are only put forward when we feel sure that they represent the very best form of practice. Time and trouble spent in preliminary investigation is seldom wasted, and preliminary experimental work, while seeming expensive, may prove to be the foundation for a greatly increased or entirely new load. For instance, we have in our area a town gas-fired vegetable oil-heating unit converted from coke firing, which is quite satisfactory, but it has been felt for some time that a fire-tube type of heater—the present form is oil-tube—would give better results. There are, however, certain possible disadvantages, and a scheme is at present under consideration for the installation of a small test unit for experimental purposes.

Service does not stop at the point of installation, however. All gas-consuming plant requires constant attention to maintain its proved high efficiency, and often the gas undertaking is in a better position to carry out efficiency trials than is the consumer. Any assistance that can be given, either directly or indirectly, must be given in order to preserve the confidence of the manufacturer. The inspection of the larger appliances and furnaces must generally extend beyond visual examination; gas consumptions should be checked and waste gas analysis tests made from time to time, and usually these tests are sufficient to show if the furnace is operating at a high efficiency. More detailed work may be necessary if, for instance, the quality of the finished product shows signs of deterioration, but close co-operation between gas undertaking and consumer will usually solve even the most difficult of problems. The consumer must be made aware that the gas undertaking is not simply an agency from which he buys a commodity, but is a business organization upon whom he can depend for expert advice and assistance.

It is not proposed to enter into any description of comparative costs and efficiencies of various competitive fuels for heating purposes, since circumstances will vary according to local conditions, but it is intended to give detailed descriptions of some of the furnaces you will see during this afternoon.

The uses of gas in the first works to be visited are many and varied, and it is proposed to take only a few of these and consider in detail the construction and manipulation of the plant in which gas has proved to be the most economical fuel used.

Lead Melting.

The application of the use of gas to lead melting has occupied the interest of the metal melting industry for some years. We at Stretford have had the opportunity of seeing many attempts of gas and oil to oust the other from this particular field. Solid fuel, gas, oil, and gas again have been tried in turn by this firm, and with the exception of two oil-fired furnaces now in use, every lead melting furnace (and there are 14 of them altogether, varying from 25 cwt. to 3 tons capacity) is gas fired.

Coke was originally used for all lead melting in direct fired furnaces, but some difficulty was experienced with very short pot life, and it was decided to install gas. The method of installing gas was to place a gas burner on the coke grate bars without any furnace modifications, but the gas consumption per ton of lead run was so high that the use of gas was abandoned. The next step was the introduction of oil. A new oil furnace expressly designed for the purpose was installed, and a consumption of 5 gallons approximately of oil per ton of lead run was obtained. This was a considerable saving in operation costs, but oil proved to save but little on maintenance costs—*i.e.*, the pot life was not improved to any great extent.

At a still later date we offered to install a gas-fired furnace on trial, giving a definite guarantee of metal output and gas consumption—in fact, a guaranteed cost per ton of metal melted. The furnace was of the latest type having a cast-iron pot built into a circular bricklined, insulated, steel-cased combustion chamber. Two burners of the velocity type, utilizing gas at a pressure of 1½ lbs. per sq. in., and entraining the necessary air for combustion from the atmosphere by means of a venturi throat, fired tangentially into the combustion chamber immediately below the bottom of the pot. Both burners were used when starting from cold, and one was sufficient for normal duty. An atmospheric burner was used for maintaining the pot

* Paper read before the Manchester District Association of Gas Engineers, Oct. 26.

contents molten over short periods of inaction such as week-ends and holidays; it was later found that this burner alone was quite sufficient for small outputs. A 25 cwt. capacity pot was capable of supplying 600 lbs. of lead every 15 minutes without any difficulty, and with perfect evenness of temperature, a very necessary factor in lead pipe manufacture. Over a period of 12 months the amount of gas consumed per ton of lead run has been under 3 therms, and this includes all gas used during melting, stand-by periods, starting up from cold, and also for "freezing" burners.

Bright Wire Annealing (Copper).

This furnace was originally producer-gas fired, and the alterations entailed for conversion to town gas firing were so great that it might more readily be called a new furnace than a conversion. This furnace is some 18 ft. long by 7 ft. 4 in. wide outside, with a water seal at each end. The muffle itself is 3 ft. 6 in. wide by 14 in. high to spring level. Five burners on each side of the furnace fire into separate combustion chambers, which allow of temperature zoning along the length of the muffle, and the flame passes completely round the muffle before passing into the recuperators, situated below the furnaces, and then to the flue.

Air is drawn by natural draught through the recuperators and into the combustion chambers. The burners are equipped with natural-draught type injectors for the admission of primary air, but the air control is actually kept closed and all the air for combustion is drawn through the recuperators and preheated.

A Leeds Northrup automatic temperature control is fitted operating both gas valve and flue damper. A by-pass arrangement is fixed across the control valve so that only a portion of the gas is subject to control.

A heavy section chain carries the copper wire coils under the inlet water seal, through the muffle, and out under the outlet water seal, returning under the furnace and recuperator to the charging end. The muffle atmosphere itself is steam, supplied from the charging end, and a pressure of approximately 2½ in.-3 in. w.g. is maintained, a blow-off valve being fitted at the discharging end.

The furnace is capable of an output of 20 cwt. of wire per hour. The following figures of consumption on various loads are indicative of the overall furnace efficiency:

Wire Output per Hour.		Gas Consumption per Ton of Wire.
12·6 cwt.	..	2,430 c.ft.
14·0 ,,	..	2,200 ,,

Bitumen Compound Melting.

Gas has been applied at these works for both continuous and intermittent bitumen compound melting processes. The systems of heating in each case are similar and only the variation in requirements have produced the slight modifications to be observed.

Continuous Melting.

In this particular case the melted compound is used for coating cotton covered aerial wire. The wire is wound on drums and immersed in the bitumen compound tank, which is D-shaped in section, 8 ft. 6 in. wide by 6 ft. 6 in. deep by 4 ft. 4 in. long inside dimensions. The tank itself is built into an outer shell and the space between the two forms the combustion chamber and flue travel for the gases. The whole combustion chamber is, therefore, totally enclosed. There are two sets of burner equipment, the first being used only for heating-up from cold. A bunsen flame is utilized and both primary and secondary air are under absolute and positive control. The burner control system is of the automatic proportioning type, utilizing air at a pressure of 1 lb. per sq. in., and is such that the proportion of gas and primary and secondary air is constant under all loads.

A primary air-gas mixture manifold serves 45 special heat-resisting jets down the length of the combustion chamber; and two secondary air manifolds, one on each side, provide the requisite air to support combustion of the flame.

The second set of burner equipment is of the natural-draught type and runs alongside the first set from one end of the tank to the other. Provision is made for a series of holes to be opened below this burner for the admission of atmospheric secondary air by natural draught.

It was originally anticipated that the first set of burner equipment would be necessary under working conditions and the natural-draught burners would be required only during shut-down periods of short duration; but so efficient is the tank construction and insulation that it has been found possible for this burner, with a gas consumption of 340 c.ft. per hour, to maintain a bitumen compound temperature of 325° F. under working conditions.

Intermittent Melting.

This tank is very similar in construction to the continuous melting tank but is used, as its name implies, for intermittent melting from cold. The tank takes a charge of 35 cwt. of bitumen compound which is completely emptied after melting.

The burner equipment is similar to that already described, but no-natural draught burner was originally fitted. However, since it may take 8-10 hours for the tank to be emptied, a small pilot burner has since been fitted, which is sufficient to keep the tank contents at a temperature of 325° F. with a gas consumption of 40 c.ft. per hour during the emptying period.

Thermostatic control of the pressure relay type is fitted to both tanks and also a gas cut-off valve which operates in case of failure of the air blower.

A Well-Equipped Heat Treatment Shop.

The second firm to be visited has what is probably the best-equipped heat treatment shop in the district.

A 6-in. service main is laid to these works and a low-pressure governor is fitted on the inlet to the 10,000 c.ft. per hour drum type meter. The governor is set to maintain a constant gas pressure of 3 in. w.g. on the meter inlet. A 4-in. main serves the heat treatment shop and a 3-in. main serves the general works. The gas consumption in the general works is small, but we are at present negotiating for a new central heating load which would fill the 3-in. main.

The heat treatment shop contains a total of eight furnaces, but it is intended to describe only three of these in detail as they represent a departure from general practice.

The large box carburizing furnace, with a hearth area of 8 ft. by 6 ft., is undoubtedly the best of its type in the district. It is built according to American Ingersoll-Rand design, and we are informed that the same furnace, without any modification in design, will operate on natural gas, manufactured gas, or oil, and give excellent results. The burner equipment consists of two low-pressure two-stage burners, each fitted with automatic mixture control and utilizing air at a pressure of 1 lb. per sq. in., firing into a combustion chamber running down one side of the furnace. A 9-in. firebrick wall 1 ft. 6 in. high separates the furnace proper from the combustion chamber, and the flame passes over this wall, under the arch, and down on to the work. The outlet ports, of which there are three, are situated on the opposite side of the furnace and the waste gases pass via these ports underneath the hearth and up the burner side of the furnace to atmosphere.

The furnace is substantially built in a steel cased framework, with 9-in. insulation and 9-in. firebrick. The door is raised and lowered by means of an electric motor and is locked into position, ensuring a perfectly gas-tight fit. The hearth is built at floor level and the carburizing boxes are run in and lowered direct on to the hearth by means of a hand-operated charging machine.

A Leeds Northrup two-point temperature recorder is fitted and hand control of the furnace results in a perfectly uniform temperature across the furnace.

It is difficult to give any consumption figures as no separate meter is fitted to any furnace, but it is estimated that from cold, a furnace temperature of 1,400° F. can be obtained in 8-9 hours with a total gas consumption of 10,000-11,000 c.ft. An operating consumption of 810 c.ft. per hour is sufficient to maintain a load of 1,500 lbs. (approx.) at a furnace temperature of 1,350° F. It must be pointed out that a very definite reducing atmosphere is maintained in the furnace and the waste gases show 1·0 to 1·5% CO.

The two other new furnaces are each of the semi-muffle type and have a hearth area 4 ft. by 2 ft. Each furnace is equipped with low-pressure single-stage burners, utilizing air at a pressure of 1 lb. per sq. in. and firing underneath the hearth. There are eight burners to each furnace, four on each side, and each two alternate burners are served by an automatic mixture control. The arrangement is such that a wide range of working temperatures can be obtained.

The furnaces are built in a cast-iron and steel framework with 4½-in. insulation and 4½-in. firebrick. The door is hand operated from a counterbalance weight. Each furnace is fitted with a Leeds Northrup single-point temperature recorder.

Again it is difficult to give accurate gas consumption figures but these furnaces can be raised to a working temperature of 1,650° F. in 5-6 hours with a total gas consumption of 3,000-4,000 c.ft. Operating at this temperature with a load of 400 lbs. the maintenance consumption is 500 c.ft. per hour.

Other items to be seen in the heat-treatment shop include two Brayshaw furnaces, one a new one with a very efficient door operation arrangement, a salt bath furnace, tip heat-

ing furnace, hot brine quenching tank, and I.C.I. gas heated degreasing plant.

The installations described have all been installed after the most careful investigation and research as to the best means of meeting the manufacturers' requirements, and the basic consideration, as in the case of almost all industrial appliances, is the cost and quality of the work produced.

Finally we wish to express our best thanks to Messrs. W. T. Glover & Co., Ltd., and Messrs. the Ingersoll-Rand Company, Ltd., for their kind permission to describe the above furnaces and to use such data as were available.

Discussion.

The PRESIDENT said the necessity for co-operation between a local gas undertaking and the manufacturers within its area of supply presented a further field for individual investigation, and again called for the display of inventive ability in applying gas in the most economical manner so as to defy competition. He thought they could certainly congratulate Colonel Carr and Messrs. Windiate and Craddock, of the staff of the Stretford Gas Undertaking, for further demonstrating the efficiency of that undertaking. They could also congratulate themselves upon the fact that they had now industrial research stations available in most districts. The scope for gas heating was stupendous. When the Ford Motor Company left the Trafford Park district of Stretford it caused great pecuniary loss to the gas undertaking. Through the energy and ability displayed by the Stretford Gas Board and its officers that loss had now been made good in a remarkably short time. This was an accomplishment from which all of them could derive great encouragement. What Stretford had done they could all try to emulate, and possibly succeed in no small measure as a result of their experience.

Col. W. M. CARR (Stretford) wished to refer to the point mentioned by the President respecting the Industrial Centre. The day was coming when there must be no boundaries in the Industry. There must be no distinction as between Stretford, Manchester, Salford, or anywhere else, so far as the well-being of the Industry was concerned. They were all so nicely connected and so much affected in obtaining business for industrial purposes by what happened in other places that they could not afford not to co-operate 100% in the matter of obtaining a 100% industrial load. Therefore he hoped that everybody within the area covered by the Association's activities, no matter what the size or condition of undertaking, would feel morally bound to support the Industrial Centre. He believed that they could give much valuable information to undertakings of a smaller capacity who were not able to afford the necessary staff to develop the business themselves without that assistance, and that that information would repay ten times over in the first two or three years any amount of small subscription which had to be paid for the operation of the centre. The subscription with regard to the area immediately surrounding Stretford had been fixed at 2s. 6d. per million c.ft. of output, but in time to come it might be found that the demands of the Centre would be such that more than one official would be required. If that proved to be the case then doubtless they would all be prepared to contribute accordingly. He must, however, point out that the Industrial Centre could not do all the work. There was some of it that they must do themselves. Even those undertakings which had no industrial staff must get in touch with manufacturers. He, personally, at Stretford had spent a tremendous amount of time in getting to know manufacturers. In the case of one particular works where they were selling practically no gas at all he hoped to sell 40 million c.ft. of gas per annum in the future. Many visits on the part of himself and his staff might be necessary before this could be achieved, and before the manufacturers concerned could be convinced that they could save great expense.

The problem to be faced was not entirely a matter of the price of gas. He would instance the bitumen tanks mentioned in the paper. When those bitumen tanks were coke-fired what had to be done when the temperature was reached was to open the doors of the coke furnaces and let an enormous amount of air through. It was necessary to keep the coke fire burning almost to the same extent as it was burning before the operation of melting. An enormous amount of excess air had to be admitted in order to keep the temperature of the tank down, and yet they had to keep the fire in play in order to maintain the tank at the temperature required. The efficiency during that maintaining period was something under 5%. By the use of gas the whole job was closed except for the admission of a balanced amount of secondary air commensurate with the requirements of the pilot flame, and the temperature could be maintained with a low consumption of 40 c.ft. of gas per hour.

The more they pursued their investigations in regard to the application for industrial purposes, the more they would be convinced of the possibility that enormous economies could be effected. A great deal could be said for proper insulation. The majority of furnaces were sold on a competitive basis, and manufacturers were inclined to consider capital cost. In the Stretford area they had almost invariably to advise manufacturers to return tenders obtained for appliances, and in almost every case they had to suggest more and better insulation than was provided in the first place. It was necessary to educate the manufacturer to demand something better from the furnace maker and to induce him to be prepared to pay for something better. Nowadays, it was found that most of the big manufacturers were prepared to consult the officials of the Stretford Gas Undertaking before they placed an order for any gas appliance. This was a position which they desired to see established in the case of every industry within the district.

Mr. T. REYNOLDS (Stockport) referred to the making of contracts at special prices. Did the price of gas become a matter of getting the best possible terms from the proposed consumer, or did it conform to a definite scale of charges regarding the consumption? He was confronted with a problem in that he was compelled to supply gas at the same rate for lighting purposes.

Mr. H. R. S. WILLIAMS (Altrincham) said that one of the points which appeared to be of great importance was mentioned under the heading of Lead Melting—namely, the utter futility of attempting to place an ordinary gas burner in an ordinary furnace, and to expect good results. The furnace must be designed for the job it had to carry out. The research work which had been carried out by the Stretford Undertaking had been of great advantage to the Industry generally. Altrincham was not an industrial area, though they had an industrial load of, approximately, 12% of the total output. The paper certainly gave the impression that if he went out for more business, even in his own small industrial area, he would be likely to get it.

Mr. A. L. JENNINGS (Spenborough) remarked that as the insulation of furnaces had been referred to in the discussion he wished to draw attention to the use of glass silk as an insulating medium. This was a practically new product in this country, and was only manufactured by two firms in Great Britain, although it was fairly extensively used on the Continent. The value of glass silk as an insulating medium was second only to that of polished aluminium, but the latter had the defect that it oxidized, and the insulating effect was lost thereby. He believed that glass silk would prove to be an insulating medium which would be of great value to the Gas Industry. In his district they had an industrial load of 33%, which it was hoped would be increased to 50%. He had found that a very large amount of research work and a great deal of contact with manufacturers was necessary over a long period of years in order to establish a close business relationship.

Mr. H. SHEWRING (Rochdale) asked if the price of gas charged to the various works which had been mentioned could be described, including any extending price which would be incurred on a two-part or three-part charge.

Mr. NORMAN HUDSON (Mirfield) observed that the Stretford Gas Board had offered to install a gas-fired furnace on trial. Had they found that in this experimental work they had had to go to the limit of offering to supply plant on trial on the understanding that if the costs did not work out at a figure which would be competitive with the fuel at present used the Stretford Gas Board accepted the liability of the cost of the trial plant? He had in mind three possible outlets for gas in his own district in which the owners of works had definitely offered to give his Company the opportunity of substantiating their claim to be able to supply a fuel which per unit of output would be lower in cost than the fuel at present used; but on the understanding that the whole of the cost was to be borne by the Gas Company. Was this kind of thing a general or an exceptional experience in the case of Stretford? Another point upon which he would like information was whether Stretford had received any assistance in the form of initial inquiries from the makers of furnaces and gas-using appliances. In his own district there seemed to be practically no initial work done in that way by appliance manufacturers. In regard to other sales organizations he had found that inquiries were passed on to the Gas Company to follow up. Sometimes it was difficult for a manager or a sales canvasser of a gas-works to obtain entry in the first instance into any particular works, and the position would be rather better if it was possible to get the appliance manufacturers to take the first step.

Mr. J. E. LISTER COOPER (Yeadon and Guiseley) thought that an important consideration which emerged from the paper was that it proved that the Industrial Gas Development Centres which were being promoted were very necessary, and no one had done more to promote the establishment of those Centres than Colonel Carr. Unfortunately the Secretary of the Industrial Gas Centre in Yorkshire was unable to be present at the meeting; had he been present he would have been able to give much information about the working of the centre in Yorkshire which was doing most excellent work. Some undertakings appeared to be rather scared by the amount of the contribution which was asked for in certain centres. In Yorkshire the cost worked out approximately at 8d. per million c.ft. of gas made, though in the case of Manchester he understood it was 2s. 6d.

Mr. W. J. SMITH (Bolton) referred to the necessity for even heating when melting lead. He had noticed in the case of samples of lead tubing when they had been bent that one surface would be quite smooth while another would be quite lumpy. Was this due to uneven heating of the surface of the lead? He would like to know what were the maximum temperatures used in the furnace and also where recuperation had gone on in the heating temperature to what temperature the flue gases were allowed to emerge from the furnace. Also, whether there had been any trouble with acid deposition, and whether the temperature had been carried fairly low in the interchange.

Mr. G. H. WINDIATE, replying to the discussion, said that the whole of the prices were based on the two-part system of charge with an amount of charge according to the maximum amount of consumption per 12 hours, and then a commodity charge based on the actual manufacturing cost. The only way in

which that standard system of charge was modified was according to the nature of the load. For instance, if a firm was prepared to take 50 million c.ft. of gas per year, and required the whole of that gas between seven in the morning and five in the afternoon, then they would have to pay more than if they took that 50 million c.ft. of gas over the whole 24 hours of the day. He thought those remarks answered Mr. Reynolds' question respecting special prices for special loads.

Mr. Jennings had raised the question of insulation. In the case of one of the bitumen tanks which would be seen during the course of the afternoon's visit glass silk had actually been used for insulation purposes. While the authors of the paper had no doubt as to its efficiency, yet it was not really a very good job. Glass silk could not usually be adapted for a flat surface, though it was useful for pipe work or a curved surface.

In regard to the use of gas for lead melting, bright wire annealing, and bitumen melting, the average price was approximately 4d. to 4¼d. per therm, which included the standing charge. In the case of the particular firm referred to in the paper the greater proportion of the gas was taken over the 24 hours of the day, but there was a certain proportion of the gas which was only taken between 7.30 and 5 o'clock. In regard to the heat-treating operations the whole of the gas was taken over the 24 hours so that the average price worked out at something between 3½d. and 4d. The prices varied from month to month because, of course, the loads varied from month to month.

In reply to Mr. Smith, Mr. Windiate said there was no doubt that gas was the ideal fuel for lead melting. A furnace had been described of 25 cwt. capacity, yet the furnace was capable of dealing with 600 lbs. of lead every 15 minutes with absolute evenness of temperature. There was no doubt that the slightest unevenness of temperature would result in a very wide variation in the composition of the lead.

A Question of Liability.

A question had been raised respecting the liability incurred when installing plant. In the case referred to in the paper the consumers had already tried out the conversion system and had found it to be somewhat unsatisfactory. It was for that reason that the Stretford Gas Board had undertaken the whole of the liability with regard to the trial plant, though it was not the general practice for them to accept such a responsibility. There was no doubt, however, that it sometimes paid to do so in the long run provided one was sure of the figures. The greater proportion of the propaganda work done in Trafford Park was due to the efforts of the Stretford Gas Board and its officials. The appliance manufacturers had not been always relied upon. The best attitude to adopt towards the appliance manufacturer was a somewhat strong one, and he thought he might say that the Board now worked quite as well with the appliance manufacturer as they did with the consumer. Very few furnace manufacturers now came into the Stretford District without consulting the Stretford Gas Board.

Mr. H. Shewring remarked that Mr. Windiate had hardly answered his question. Mr. Windiate had referred to a two-part system and then a commodity charge, and mentioned a figure of 50 million c.ft. over a period of 24 hours. According to a paper read by Mr. James Carr to the Manchester Juniors on Oct. 6, they had been informed that the net cost of gas in the holder for the year ended March 31, 1934, was 1·53d. per therm. It was stated in the paper that the distribution costs were very low owing to the concentration of several large customers in a small area fairly near to the manufacturing station. He did not desire to be inquisitive, and perhaps it was not the policy of the Stretford Gas Board to disclose their prices, but if some indication of the prices per therm or per 1,000 c.ft., could be given, after the commodity charge had been taken into consideration, based on the 50 million c.ft., it would be extremely useful information not merely to himself but also to several undertakings who were now negotiating for industrial loads.

Col. Carr, replying to the question upon the invitation of the President, said there was a two-part tariff at Stretford. In addition to the industrial two-part tariff there was an industrial two-block system in operation. In one case all the load—a very valuable one—was taken in the summer time, for the purpose of making ice-cream wafers. If the load was a 24 hour load the demand charge was based on the maximum 12-hourly demand, and if the load was only on a day-shift there was a higher demand charge than was the case with the works that was working over the 24 hours. A 50 million c.ft. of gas consumption with a uniform demand charge might possibly bring the price of gas down as low as 3d. per therm. Taking the bulk supply during a few hours daily the price of the gas might be 4½d. to 5d. per therm because, of course, it cost so much more to get it delivered. The Board were at present negotiating for a contract with a steel works in connection with which there was a peculiar demand and peculiar circumstances; but nevertheless they tried to maintain equitable conditions as between all their customers, and to see that as far as possible they were all treated alike. It was very difficult to set up a scientifically sound division in order to make sure that everybody was fairly balanced, but the two-part tariff had helped in the case of Stretford. Most of the large consumers in the Stretford District had gone on to it, although two of them preferred to remain on the block system because their demand was such that it made the block system more favourable than the two-part tariff.

Mr. A. L. Holton moved that a hearty vote of thanks be accorded to the authors of the paper, and Mr. Crowther seconded.

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Gas Markets and Manufactures

Stock Market Report.

[For Stock and Share List, see later page.]

The chief feature of Stock Exchange affairs last week was the heavy buying of British Funds and other high-class investments, which included some substantial orders from abroad, and several quotations reached new high levels. Elsewhere conditions were dull, apart from the interest in a few specialities, though the general tone remained steady.

The Gas market, following in the wake of the Funds, was also well supported, and many issues made further substantial improvement. Gas Light units, after a rise of 9d. the previous week, gained a similar amount last week to 28s. 6d., at which price the yield is brought down to £3 18s. 7d.%. This is the lowest return on any ordinary gas stock at the present time, though the yield on other leading stocks is very little above this figure, which not only indicates the popularity of "gas" as an investment, but also the continued belief in the public demand for the commodity. Another large gain was that of Derby consolidated, which improved 10 points to 192½ on the Nottingham Exchange. It will be noticed that the Lea Bridge stock, on which a similar rate of dividend to that of Derby (8½%) has been distributed for the past five years, is quoted at 169 only. South Metropolitan ordinary and 6% preference both hardened 3, and it will be seen in the Stock and Share List that many other issues gained from 1 to 5 points.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Oct.* 29.

There is little alteration to report in the prices of tar products.

Pitch is quiet at about 55s. per ton f.o.b.

Creosote is firm at 4d. to 4¼d.

Refined tar, 4d. to 4½d. per gallon in bulk at makers' works.

Pure toluole, about 2s. 2d.; pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, about 1s. 7d.; and 90/160 pyridine, 6s. 6d. to 7s.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Oct. 29.

The average prices of gas-works products during the week were: Gas-works tar, 23s. to 28s.; Pitch—East Coast, 50s. to 52s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 50s. to 52s. 6d.* Toluole, naked, North, 1s. 6d. to 1s. 8d. Coal-tar crude naphtha, in bulk, north, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4½d. Heavy naphtha, North, 9¾d. to 10¾d. Creosote, *ex* works, in bulk, North, liquid and salty, 3⅜d. to 3½d.; low gravity, 3⅜d. to 3⅝d.; Scotland, 3¼d. to 3½d. Heavy oils in bulk, North, 3⅜d. to 4¼d. Carbolic acid, 60's, 1s. 8d. to 1s. 9d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Oct.* 27.

Market is quiet and although, in the meantime, actual quotations show little or no alteration, the general position is, nevertheless, easier.

Crude gas-works tar is now 30s. to 32s. per ton *ex* works in bulk.

Pitch remains dull and actual value of vertical quality is now 43s. to 44s. per ton f.o.b. Glasgow for export, and 40s. to 42s. 6d. per ton *ex* works in bulk for home.

Refined tar remains unchanged at 3d. to 3⅜d. per gallon naked at makers' works.

Creosote oil is not so brisk but, as stocks are low, prices remain unaltered. B.E.S.A. Specification, 4d. to 4¼d. per gallon; low gravity, 4½d. to 4¾d. per gallon; and neutral oil, 4¼d. to 4½d. per gallon; all f.o.r. in bulk.

Cresylic acid is in better call. Pale, 97/99%, is 1s. 3d. to 1s. 4d. per gallon; dark, 97/99%, 1s. 0½d. to 1s. 1½d. per gallon; and pale, 99/100%, 1s. 4½d. to 1s. 5½d. per gallon; all *ex* works.

Crude naphtha is commanding 4½d. to 5d. per gallon, according to quality.

Solvent naphtha.—90/160 grade is 1s. 3d. to 1s. 4d. per gallon, while 90/190 grade remains nominal at 8d. per gallon.

Motor benzole.—1s. 5d. per gallon (nominal).

Pyridines.—90/160 grade is 6s. 6d. to 7s. per gallon, and 90/140 grade 6s. 9d. to 7s. 9d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	9	to	0	9½	per gallon at works
Motor ,,	1	3½	,,	1	4	,, ,, ,,
90% ,,	1	4	,,	1	4½	,, ,, ,,
Pure ,,	1	7½	,,	1	8	,, ,, ,,

Contracts Advertised To-Day.

Carburetted Water Gas Plant.

Gisborne Gas Company, Ltd., New Zealand. [p. 380.]

Coal.

Oldbury Gas Department. [p. 380.]

Cookers, Fires, and Other Appliances.

Belfast Gas Department. [p. 380.]

Gasholder Repairs, &c.

Gainsborough Gas Department. [p. 380.]

Meters.

Belfast Gas Department. [p. 380.]

Pipes and Specials.

Clacton-Gas and Water Department. [p. 380.]

Trade Notes.

B.E.N. Patents, Ltd.

Messrs. B.E.N. Patents have recently issued an attractive catalogue which deals with a complete range of modern air compressors, paint spray equipment, and air fittings, manufactured entirely in Great Britain and suited to the varying requirements of industry generally.

An "Ascot" Innovation.

To supplement their sales staff at the North London Exhibition (which closed on Saturday last), Messrs. Ascot Gas Water Heaters, Ltd., engaged, with very successful results, the services of a professional entertainer. Appearing first as a "star" turn featuring Ascot appliances in the variety theatre of the Exhibition, he continued his activities on the Company's stand, where his jocular method of extolling the merits of the attractively displayed exhibits did much to stimulate the interest of visitors.

Compound Coke Ovens by Simon-Carves, Ltd.

Messrs. William Dixon, Ltd., ironmasters and colliery owners, of Glasgow, have placed an order with Simon-Carves, Ltd., of Cheadle Heath, near Manchester, for a complete bye-product coking plant to be erected at their Govan Iron Works, Glasgow. The coking plant will consist of a battery of 50 "Underjet" compound coke ovens, equipped for firing with coke oven gas or blast furnace gas. The ovens will have a capacity of approximately 900 tons of coal per day. Messrs. Simon-Carves' contract also includes foundations and buildings, the erection of complete coal receiving, handling, and crushing equipment, a 2,000-ton concrete coal bunker, coke quenching station, and a screening plant for furnace and domestic coke. The bye-product plant includes a benzole plant for the production of motor spirit. A Simon-Carves' static type electrical detarrer will also be installed. In addition, Messrs. Simon-Carves are to provide the necessary steam raising plant, all electric wiring and apparatus, and water storage requirements and mains.

Metropolitan Gas Companies' Testings.

The Gas Referees' report on the official testings for the past quarter gives the following average calorific values for the gas supplied by the Metropolitan Companies named:

Commercial Gas Company.—501·0 B.Th.U. (declared calorific value, 500 B.Th.U.).

Gas Light and Coke Company.—501·9 B.Th.U. (declared calorific value, 500 B.Th.U.).

South Metropolitan Gas Company.—561·7 B.Th.U. (declared calorific value, 560 B.Th.U.).

South Suburban Gas Company.—560·7 B.Th.U. (declared calorific value, 560 B.Th.U.).

Tottenham and District Gas Company—500·4 B.Th.U. (declared calorific value, 500 B.Th.U.).

Wandsworth and District Gas Company.—502·0 B.Th.U. (declared calorific value, 500 B.Th.U.).

The changes in regard to the statutory obligations of gas undertakers introduced in the Gas Undertakings Act, 1934, preclude the issue of similar Quarterly Certificates by the Gas Referees in future, and the Reports of the Gas Examiners for the various examination areas will henceforth take the place of the Referees' Quarterly Certificate.

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Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Oct. 26.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Sept 10	7	7	Alliance & Dublin Ord. ...	135—145	+3	139—141½
374,000	"	June 25	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
557,655	"	Aug. 13	7	7	Barnet Ord. 7 p.c.	165—170	...	...
300,000	1	Oct. 8	1/9¼	1/4½	Bombay, Ltd.	1⅝—1⅝	+1/-	30/6—31/-
178,480	Stk.	Aug. 13	9½	9½	Bournemouth sliding scale	225—230	...	...
550,050	"	"	7	7	Do. 7 p.c. max. ...	168—173	...	170½
439,160	"	"	6	6	Do. 6 p.c. Pref. ...	142—147	...	...
50,000	"	June 11	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
262,025	"	"	4	4	Do. 4 p.c. Deb. ...	105—110	...	109½
335,000	"	"	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
357,900	"	Aug. 13	7½	7½	Brighton, &c., 6 p.c. Con. ...	173—178	+1	176½—177½
540,000	"	"	6¾	6¾	Do. 5 p.c. Con. ...	155—160	...	159½
195,500	"	"	6	6	Do. 6 p.c. B. Pref.	142—147	...	...
1,487,500	"	July 9	5	5	Bristol 5 p.c. max.	120½—121½*a*	...	...
120,420	"	June 11	4	4	Do. 1st 4 p.c. Deb. ...	102—105*a*	...	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	102—105*a*	...	...
328,790	"	"	5	5	Do. 5 p.c. Deb.	123—125*a*	...	...
855,000	"	Sept. 24	8	7	British Ord.	162—167	+4	164—166
100,000	"	June 11	7	7	Do. 7 p.c. Pref.	154—159	...	...
350,000	"	"	5½	5½	Do. 5½ p.c. Pref.	112—117	...	...
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	98—103	...	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	107—115	...	...
160,000	"	June 11	5	5	Cambridge 5 p.c. Deb. ...	115—120	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	2—4	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	4—6	...	...
150,000	Stk.	July 23	4½	4½	Do. 4½ p.c. Deb. ...	90—95	...	...
626,860	"	July 23	6	6	Cardiff Con. Ord.	132—137	+1	136½
237,860	"	June 11	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
157,150	"	July 23	6½	5	Chester 5 p.c. Ord.	118—118*b*	...	...
98,986	1	Sept. 24	2/-	2/-	Colombo, Ltd. Ord.	1⅞—1⅞	...	...
24,500	1	"	1/4½	1/4½	Do. 7 p.c. Pref. ...	19/6—21/6	...	...
609,204	1	Sept. 24	/11'48	/11 48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	...
296,053	1	"	1/8'30	1/8 30	Do. 8 p.c. Pref.	24/6—26/6	...	26/-
1,775,005	Stk.	July 23	6½	5	Commercial Ord.	120—125	...	122—123
475,000	"	June 11	3	3	Do. 3 p.c. Deb. ...	83—88	...	...
286,344	"	Aug. 13	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
807,560	"	Aug. 13	7	7	Croydon sliding scale ...	158—163	...	162½
569,590	"	"	5	5	Do. max. div.	107—113	...	...
620,385	"	June 25	5	5	Do. 5 p.c. Deb.... ...	123—128	...	126
542,270	"	Aug. 13	10	7	Derby Con.	190—195*e*	+10	...
55,000	"	June 25	4	4	Do. 4 p.c. Deb.	100—105*e*	...	...
209,000	"	Aug. 13	5	5	East Hull Ord. 5 p.c. ...	108—112	...	...
181,625	"	Aug. 13	6	6	East Surrey Ord. 5 p.c. ...	137—142	+5	...
175,609	"	June 11	5	5	Do. 5 p.c. Deb. ...	120—125	...	...
1,002,180	"	Sept 10	17	15	European, Ltd.	122—127	...	123⅜—125
19,342,763	"	Aug. 13	5⅜	5⅜	Gas Light & Coke 4 p.c. Ord.	28/—29/-*f*	+/9	27/10½—28/7½
2,600,000	"	"	3½	3½	Do. 3½ p.c. max.	88—91	...	...
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	106—109	...	108—109
6,109,497	"	May 28	3	3	Do. 3 p.c. Con. Deb. ...	88—91	...	89—90
3,643,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	116—119	...	...
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	114—117	...	115½—116
270,466	"	Aug. 13	6	6	Harrogate New Cons. ...	127—132	...	...
140,000	1	Sept. 24	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅝—1⅝*	...	...
213,200	Stk.	Aug. 13	6	6	Hornsey Con. 3½ p.c. ...	137—142	...	...
5,600,000	"	Oct. 22	14	10	Imperial Continental Cap.	209—214*	−7	207—215
228,180	"	July 23	3½	3½	Do. 3½ p.c. Red. Deb.	92—97	...	...
235,242	"	Aug. 13	8½	8½	Lea Bridge 5 p.c. Ord. ...	166—172	...	...
2,167,410	"	Aug. 13	6	6	Liverpool 5 p.c. Ord. ...	136—137*b*	+1	...
245,500	"	June 11	5	5	Do 5 p.c. Red. Pref. ...	105—110*b*	−½	...
306,088	"	July 16	4	4	Do. 4 p.c. Deb. ...	102—104*b*	...	...
11,751	"	Aug. 27	10	8	Maidstone 5 p.c. Cap. ...	180—190	...	...
63,480	"	June 25	3	3	Do. 3 p.c. Deb. ...	75—80	...	...
75,000	"	May 28	†10	†10	Malta & Mediterranean ...	200—210	...	...
329,000	—	Oct 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—103	...	...
231,978	Stk.	Aug. 13	5	5	M. S. Utility "C." Cons. ...	111—116	...	...
818,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	97—102	...	...
360,075	"	June 11	4	4	Do. 4 p.c. Deb. ...	100—105	...	102½—105¾
148,955	"	"	5	†5	Do. 5 p.c. Deb.	122—127	+3	...
125,000	—	July 2	...	11/8	Do 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	"	May 28	†6	†3	Montevideo, Ltd.	60—65	...	...
2,061,315	"	Aug. 13	5‡	5	Newcastle & Gateshead Con.	25/6—26/6*d*/	+/3	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	103—105*d*	...	...
776,706	"	June 11	3½	3½	Do. 3½ p.c. Deb. ...	92½—93½*d*	...	...
277,285	"	May 7	5	5	Do. 5 p.c. Deb. '48 ...	108—107*d*	...	...
274,000	"	Aug. 13	5	5	Newport (Mon.) 5 p.c. max.	106—108*a*	+1	...
204,940	"	Aug. 13	7½	7½	North Middlesex 6 p.c. Con.	155—160	...	...
396,160	"	Aug. 13	5	5	Northampton 5 p.c. max. ...	107—112	...	...
300,000	"	May 7	†7	†7	Oriental, Ltd.	170—175	...	...
416,617	"	June 11	8	8	Plym'th & Stonehouse 5 p.c.	178—183	...	...
504,416	"	Aug. 13	8	8	Portsm'th Con. Stk. 4 p.c. Std	177—182	...	...
241,446	"	"	5	5	Do. 5 p.c. max. ...	105—110	...	...
114,000	"	July 23	5	5	Preston 5 p.c. Pref. ...	101—106	...	...
1,736,968	Stk.	Aug. 27	6	6	Sheffield Cons.	139—141*e*	...	...
95,000	"	July 9	4	4	Do. 4 p.c. Deb.	100—104*	...	...
133,201	"	Aug. 13	5	8½	Shrewsbury 5 p.c. Ord. ...	137—142	...	140
90,000	10	May 28	†4	†3	South African	2—4	...	...
927,177	1	Sep. 10	1/2‡	1/2‡	South East'n Gas Cn. Ld Ord.	28/—30/-	...	29/4½
736,061	1	"	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	22/—23/-	...	22/6—22/10½
450,000	Stk.	Aug. 13	74/4	4	Do. 4 p.c. Red. Deb. ...	102—105	...	...
6,709,895	"	Aug. 13	7	5	South Met. Ord.	142—145	+3	141—145
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	145—150	+3	146—148½
850,000	"	"	4	4	Do. 4 p.c. Irred. Pf.	104—107	...	105½
1,895,445	"	June 25	3	3	Do. 3 p.c. Deb ...	87—90	...	...
1 000,000	"	July 9	5	5	Do. 5 p.c. Red. Deb.	116—118	...	116—118
209,820	"	Aug. 13	8½	8½	South Shields Con.	169—171*d*	...	...
1,543,795	"	July 9	6	6	South Suburban Ord. 5 p.c.	133—136	...	135—136
512,825	"	"	5	5	Do. 5 p.c. Pref.	122—127	...	126½
300,000	"	"	4	4	Do. 4 p.c. Pref.	101—106	...	...
868,837	"	June 11	5	5	Do. 5 p.c. Deb.	123—128	...	...
100,000	"	"	4	4	Do. 4 p.c. Deb.	102—107	...	...
647,740	"	Aug. 13	5	5	Southampt'n Ord. 5 p.c. max.	112—117	...	...
121,275	"	June 11	4	4	Do. 4 p.c. Deb.	99—104	...	...
350,000	"	Aug. 13	5½	5½	Swansea 5½ p.c. Red. Pref.	110—115	+3	112
200,000	"	June 11	6½	6½	Do. 6½ p.c. Red. Deb.	102—107	...	...
1,076,490	"	Aug. 13	6¾	6¾	Tottenham and District Ord.	155—160	...	158—160
409,835	"	"	5½	5½	Do. 5½ p.c. Pref. ...	130—135	...	133
62,235	"	"	5	5	Do. 5 p.c. Pref. ...	118—123	...	...
199,005	"	June 11	4	4	Do. 4 p.c. Deb. ...	100—105	...	...
349,110	"	Aug. 13	7	7	Uxbridge, &c., 5 p.c. ...	163—168	...	165
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	124—129	+3	...
1,326,700	"	Aug. 13	7	7	Wandsworth Consolidated	160—165	...	162—164½
1,371,373	"	"	5	5	Do. 5 p.c. Pref.	124—129	+3	125
1,317,964	"	June 11	5	5	Do. 5 p.c. Deb.	123—128	...	...
203,300	"	"	...	26/8	Do. 4 p.c. Deb.	104—107	...	...
158,400	"	Aug. 13	6*g*	5	Winchester W. & G. 5 p.c. Con.	120—125	...	...

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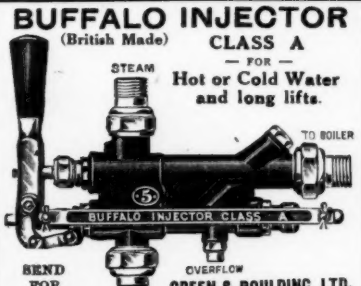

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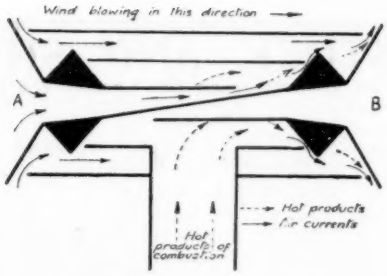

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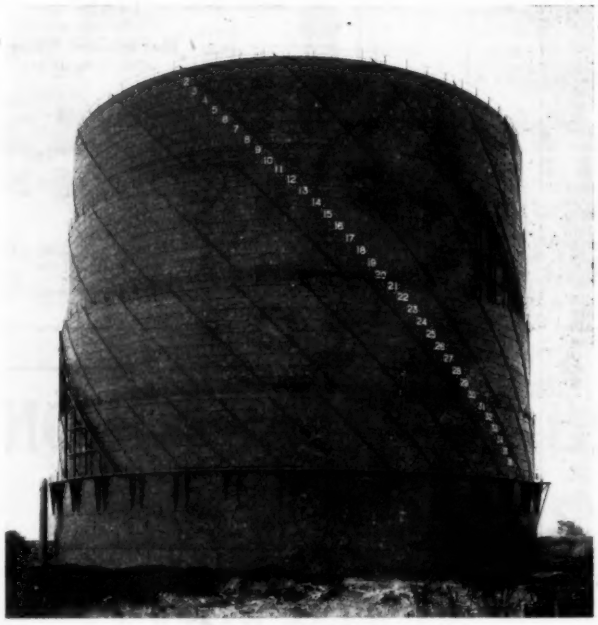

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